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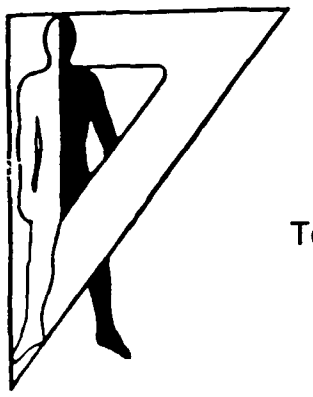

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Technical Memorandum 23-89

# LIGHT INFANTRY DIVISION AMMUNITION LOGISTICS ENHANCEMENTS

G. A. Kupets, Sr.
A. H. Anderson
H. L. Barrett, Jr.

ASI Systems International

December 1989
AMCMS Code 612716.H700011



U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

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The objective of this study was to assess and resolve ammunition handling, storage, and transportation deficiencies within light infantry divisions (LIDs). The methodology consisted of a detailed literature search and document review; the compilation of data to support baseline requirements; the development and analysis of baseline requirements; visits to four Army divisions, a Corps headquarters, and agencies involved in the development of concepts and hardware supporting the LID's ammunition logistics system; the identification, compilation, and analysis of shortcomings and deficiencies; the identification of fixes; and the development of an investment strategy.

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The primary focus of the study was on hardware; however, in the analysis of the information gathered, it was determined that other aspects of the LID ammunition logistics system are noteworthy. In addition to hardware recommendations, this report includes information developed on other aspects of the system.

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# LIGHT INFANTRY DIVISION AMMUNITION LOGISTICS ENHANCEMENTS

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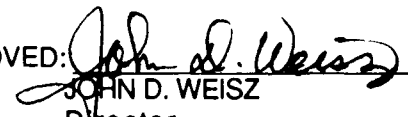
APPROVED: 

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Lieutenant Colonel Michael Fairhead, Assistant G-3, Plans, Headquarters, I Corps

Major Gary L. Motsek, Division Ammunition Officer (DAO), 10th Mountain Division, (Light Infantry)

Chief Warrant Officer J. C. M. McCoy, Division Ammunition Technician, 10th Mountain Division (Light Infantry)

Major William O. Henry, DAO, 9th Infantry Division (Motorized)

Captain J. S. Jones, DAO, 7th Light Infantry Division

Mr. Bruno Sinigaglio, Team Chief, HEL Liaison Office, U.S. Army Development and Employment Agency

CONTENTS

## TERMS, ABBREVIATIONS, AND ACRONYMS

| | |
|---|---|
| ADA | Air Defense Artillery |
| ADCS | Assistant Division Commander for Support |
| ADEA | Army Development and Employment Agency |
| ALOC | Air Lines of Communications |
| ARTY | Artillery |
| ASP | Ammunition Supply Point |
| ATP | Ammunition Transfer Point |
| AVIM | Aviation Maintenance |
| BDE | Brigade |
| BLT | Battalion Landing Team |
| BN | Battalion |
| BSA | Brigade Support Area (Army) |
| BSA | Beach Support Area (Marine Corps) |
| BSSG | Brigade Service Support Group (Marine Corps) |
| BTRY | Battery |
| CBT | Combat |
| CEWI | Combat Electronic Warfare and Intelligence |
| CH | Charge (Propellant Charge) |
| CINC | Commander in Chief |
| CINCLANTFLT | Commander in Chief, Atlantic Fleet |
| CMMC | Corps Materiel Management Center |
| CINCPACFLT | Commander in Chief, Pacific Fleet |
| CO | Company |
| COMMZ | Communications Zone |
| CONUS | Continental United States |
| COSCOM | Corps Support Command |
| CS | Combat Support |
| CSA | Corps Storage Area |
| CSA | Chief of Staff of the Army |
| CSR | Controlled Supply Rate |
| CSS | Combat Service Support |
| CSSD | Combat Services Support Division |
| DA | Department of the Army |
| DACS | Defense Ammunition Center and School |
| DAO | Division Ammunition Officer |
| DISCOM | Division Support Command |
| DMMC | Division Materiel Management Center |
| DS | Direct Support |
| DSA | Division Support Area |
| FASCO | Forward Area Support Coordinator |
| FMF | Fleet Marine Forces |
| FMFPAC | Fleet Marine Force Pacific |
| FORSCOM | Forces Command |
| FSC | Forward Supply Company |
| FSSG | Force Service Support Group (Marine Corps) |
| GS | General Support |
| HEL | Human Engineering Laboratory |
| HELFAST | Human Engineering Laboratory Forward Ammunition Supply and Transfer |
| HHC | Headquarters and Headquarters Company |
| HHB | Headquarters and Headquarters Battery |
| HMMWV | High Mobility Multipurpose Wheeled Vehicle |

| | |
|---|---|
| HNS | Host Nation Support |
| IH | International Harvester |
| IPR | In-Process Review |
| JTF | Joint Task Force |
| KMPH | Kilometers Per Hour |
| LAV | Light Armored Vehicle |
| LAW | Light Artillery Weapon |
| LID | Light Infantry Division |
| LOC | Lines of Communications |
| LOGCEN | U.S. Army Logistics Center |
| LOGMARS | Logistics Marking and Reading Symbols |
| LT | Light |
| LZSA | Landing Zone Support Area |
| MAG | Marine Air Group |
| MAGTF | Marine Air and Ground Task Force |
| MEB | Marine Expeditionary Brigade |
| MEF | Marine Expeditionary Force |
| MEU | Marine Expeditionary Unit |
| MHE | Materials-Handling Equipment |
| MMC | Materiel Management Center |
| MNVR | Maneuver |
| MOADS | Maneuver-Oriented Ammunition Distribution System |
| MOS | Military Occupational Specialty |
| MRO | Materiel Release Order |
| MSM | Munitions Systems Manager |
| MTOE | Modified Table of Organization and Equipment |
| NATO | North Atlantic Treaty Organization |
| NBC | Nuclear, biological, and chemical |
| NCO | Noncommissioned Officer |
| NDI | Nondevelopmental Item |
| NSN | National Stock Number |
| OMMCS | Ordnance, Missile, and Munitions Center and School |
| PAM | Pamphlet |
| PIP | Product Improvement Program |
| PLS | Palletized Loading System |
| PM AMMOLOG | Program Manager, Ammunition Logistics |
| PROJ | Projectile |
| PROP | Propellant |
| PUL | Preconfigured Unit Load |
| RACO | Rear Area Combat Operations |
| RAP | Rocket-Assisted Projectile |
| REIN | Reinforced |
| RLT | Regimental Landing Team |
| RSR | Required Supply Rate |
| S&P | Stake and Platform |
| S&T | Supply and Transportation |
| SEALOC | Sea Lines of Communications |
| SEP | Separate |
| SMLS | Seabased-Mobile Logistics System |
| SOP | Standing Operating Procedure |
| SPT | Support |
| S/T | Short Ton(s) |
| STGR | Stinger (Missile System) |
| T/E | Table of Equipment (Marine Corps) |
| TMT | Transportation Motor Transport |

| | |
|---|---|
| STGR | Stinger (Missile System) |
| T/E | Table of Equipment (Marine Corps) |
| TMT | Transportation Motor Transport |
| T/O | Table of Organization (Marine Corps) |
| TO&E | Table of Organization and Equipment |
| TOW | Tube-Launched, Optically Tracked, Wire Command-Link Guided |
| TRADOC | U.S. Army Training and Doctrine Command |
| TRK | Truck |
| TRLR | Trailer |
| TSA | Theater Storage Area |
| UBL | Unit Basic Load |
| UCL | Unit Configured Load |
| USMC | United States Marine Corps |
| 6 K | 6,000 Pounds |
| 10 K | 10,000 Pounds |

# EXECUTIVE SUMMARY

The objective of the Light Infantry Division (LID) Ammunition Logistics Enhancements study was to assess and resolve ammunition handling, storage, and transportation deficiencies within the light infantry divisions.

The methodology consisted of a detailed literature search and document review; the compilation of data to support baseline requirements; the development and analysis of baseline requirements; visits to four Army divisions, a Corps headquarters, and agencies involved in the development of concepts and hardware supporting the LID's ammunition logistics system; the identification, compilation, and analysis of shortcomings and deficiencies; the identification of fixes; and the development of an investment strategy.

The primary focus of the study was on hardware; however, in the analysis of the information gathered during visits to the four divisions, it was determined that other aspects of the LID ammunition logistics system are noteworthy. Based on guidance provided during in-process reviews (IPRs), this report, in addition to hardware recommendations includes information developed on other aspects of the system.

Significant findings include

## Transportation

Most LID units have a significant shortfall in their capability to transport organic equipment and haul ammunition basic loads.

### Ground

- Not all ammunition loads (packages) to be transported by the high mobility, multipurpose wheeled vehicle (HMMWV) fit between the wheel wells.

- Artillery personnel prefer the 5-ton or the 2-1/2-ton truck to the HMMWV as the prime mover for the 105mm howitzer because of total load requirements. A 105mm howitzer battery cannot move as a battery and conduct concurrent ammunition resupply operations.

- Based on experience gained during exercises, the LID will not be able to effectively and quickly clear the airhead without drop-side 5-ton trucks and stake and platform (S&P) trailers.

- Limited quantities of transportation and driver assets, coupled with the anticipated distances from the user to the ammunition supply point (ASP) will severely limit or even preclude the users' ability to conduct resupply operations between their positions and the ASP.

- A smaller palletized loading system (PLS) (e.g., 5 ton) would have applications in the LID under the maneuver-oriented ammunition distribution system (MOADS) concept, especially for artillery units with anticipated high tonnages of ammunition expenditures.

### Air

Among the LIDs visited, the standing operating procedure (SOP) for the planned use of helicopter assets differs (maneuver versus resupply versus medical evacuation).

## Handling and Storage

### Vehicle Materials-Handling Equipment (MHE)

Five-ton trucks dedicated to Class V resupply do not have on-board MHE to self-load and unload heavy pallets of ammunition.

### Other MHE

- An air-transportable 10,000-pound (10-K) forklift has been authorized for issue to the LIDs to replace the 10-K rough terrain forklift (not air-transportable) and some of the 6,000-pound (6-K) forklifts on a one-for-one basis.

- The loading and unloading of PLS pallets require an MHE capability. This is especially burdensome in units that have a high tonnage of ammunition expenditures (e.g., artillery units) and no MHE to handle the pallets.

- There is a need for MHE that has the characteristics and capabilities of unit basic load (UBL)-upload equipment.

- The division support command (DISCOM) lacks sufficient quantities of pallets and slings to conduct effective training and to efficiently accomplish resupply functions.

### Ammunition Transfer Point (ATP) Operations

- Given the numbers of authorized forklifts and forklift operators, ATP personnel anticipate difficulty to transload the required tonnage of 250 short tons (S/T) of ammunition per day in a combat environment.

- Based on the extensive experience of ATP personnel, sectional ramps with rollers and powered conveyor belts have been used advantageously with boxed ammunition in ATP and similar ammunition transloading operations.

## Packaging

- The current method of ammunition packaging is a logistician's solution to wholesale distribution. This has been a dilemma for all Army divisions; however, considering the Spartan nature of the LID, the situation presents a more difficult problem for the LID.

• The packaging of 81mm mortar rounds in two-round units does not fall in line with the infantry commanders' practice of one round per soldier. One-round packages are preferred.

Personnel

• The division ammunition office (DAO), with only six people, is understaffed.

• In garrison, ammunition handlers (military occupational specialty [MOS] 55B) perform non-MOS duties and rarely train in their MOS.

• LID personnel resources permit establishing only three ATPs (design concept). An ATP section of only eight people does not permit drawing down on the three authorized ATPs to man a fourth ATP. An ATP is limited to two 6-hour shifts in a 24-hour period (again, design concept).

• The addition of a fourth ATP to the LID would enhance the Class V resupply and mission accomplishment of the separate 155mm howitzer battery and alleviate some of the burden of Class V resupply of other divisional units that are required to draw ammunition from the ASP.

Communications and Accountability

• The current system of communications and control is unresponsive.

• Key personnel, activities, and nodes within the system at the division level and below do not possess the communications or data transmission capability to effectively control Class V operations. Three examples illustrating the problems are

1. The division ammunition officer (DAO) cannot communicate directly with his representative at any of the ATPs.

2. Ammunition convoy commanders and drivers have no method of communicating with their units, the ATP, or the ASP.

3. The DAO must interact with no fewer than 17 organizations in the exchange of information and data. The DAO has no means to transmit or receive data in real time or near real time.

• The manual system for maintaining inventory and accountability at the ASP is time-consuming, labor-intensive, and can be inaccurate.

Doctrine and Concepts

There are apparent deficiencies and shortcomings in the Class V logistics system. Some of these deficiencies and shortcomings are well recognized within the Army logistics community and they are receiving attention. The conclusions that follow impact the short-term readiness of the LID and were developed through the described methodology in response to the objective of the study.

• The concept and TO&E (Table of Organization and Equipment) resources that support the establishment of the ATPs apparently render, in practice, a makeshift operation. LID personnel believe that a fourth ATP or an increase in resources for the three authorized ATPs is essential to mission accomplishment.

• LID personnel desire 100% ammunition throughput to the ATP.

• LID plans for combat service support (CSS) in the objective area are inconsistent relative to the availability of corps assets normally required to support a division.

Miscellaneous

• Based on the recommendation of some LID unit commanders, including one senior LID commander, actions could be taken under the direction of the Logistics Center (LOGCEN) that would assist in identifying and resolving suspected problem areas and "unknowns" in the LID CSS system. These actions could include field exercises and/or computer simulations.

• There is no single organization or document that can provide comprehensive ammunition expenditure data on all weapons in the Army's current inventory.

# LIGHT INFANTRY DIVISION AMMUNITION LOGISTICS ENHANCEMENTS

## INTRODUCTION

This report documents a study of ammunition logistics in the U.S. Army Light Infantry Division (LID) conducted by ASI Systems International (ASI). The study was conducted for the U.S. Army Human Engineering Laboratory (HEL) in conjunction with the U.S. Army Program Manager for Ammunition Logistics (PM AMMOLOG).

## BACKGROUND

The resupply of ammunition on the modern battlefield is of critical concern to commanders and logisticians at every level. New weapon systems, smart munitions, high firing rates, rapid movement of weapons on the battlefield, and new logistics concepts such as the palletized loading system (PLS) make ammunition resupply a critical factor in success on the battlefield. The mission of the light infantry division requires that ammunition-handling capabilities be consistent with the mobility requirements of the light forces.

The Combat Services Support Division (CSSD) of HEL, has several years of experience in assessing combat unit ammunition-handling material, capabilities, and bottlenecks; operational capabilities; and organizational structures. HEL has demonstrated the ability to develop low-cost, innovative, nondevelopmental approaches to labor-saving ammunition storage, handling, and transportation tasks. There is a need to assess the capabilities of the light divisions to handle, carry, and store the ammunition required for unit basic loads and resupply. The result of this study is an assessment of the ammunition storage and handling capabilities and recommendations to improve those capabilities.

## OBJECTIVE

The objective of this study was to assess and resolve ammunition handling, storage, and transportation deficiencies within the light infantry divisions by establishing a plan for product improvement, and materiel development activities for the enhancement of ammunition logistics capabilities for the light infantry division. The scope of the study includes the current Class V resupply capabilities and limitations of the individual maneuver battalions, a "typical" brigade, and the support command of an LID and the nondivisional direct support (DS) organizations that provide Class V support. *(Note. The 7th Light Infantry Division was used as the basis of this study. Insights into the capabilities and requirements of light infantry divisions were also gained by reviewing the U.S. Marine Corps' [USMC] Class V resupply objectives and organizations.)*

## METHODOLOGY

The basic methodology consisted of a detailed literature search and document review; the compilation of data to support baseline requirements; the development and analysis of baseline requirements; visits to Army field units and agencies involved in the development of concepts

and hardware to support the LID's ammunition logistics system; the identification, compilation, and analysis of shortcomings and deficiencies; the identification of fixes; and the development of an investment strategy. Follow-on discussions and telephone conversations were used to supplement the information and data obtained during the initial visits.

The literature search included

- U.S. Army doctrinal publications
- U.S. Army tables of organization and equipment (TO&Es)
- Reports about hardware development
- Reports about field tests on concepts and hardware
- U.S. Marine Corps doctrinal publications
- U.S. Marine Corps TO&Es
- Current professional literature, both foreign and domestic

The following organizations were visited:

- The 7th LID, Fort Ord, California
- The 10th Mountain Division (Light Infantry), Fort Drum, New York
- The 9th Infantry Division (Motorized), Fort Lewis, Washington
- The 3rd Brigade, 29th LID, U.S. Army National Guard, Pikesville, Maryland
- I Corps Headquarters, Fort Lewis, Washington
- PM AMMOLOG, Picatinny Arsenal, New Jersey
- Headquarters, U.S. Marine Corps, Washington, DC
- Marine Corps Development and Education Command, Quantico, Virginia

A copy of the visit overview is provided in Appendix A.

Two in-process reviews (IPRs) were conducted at appropriate stages during the study for Government representatives from HEL and PM AMMOLOG. Required guidance, based on interim results, was provided by the Government representatives during the IPRs.

The specific purpose of the literature search and review and the visits are addressed in the following section of this report.

## TASKS

### Subtask Number 1

The LID baseline ammunition requirements were estimated and the baseline resupply capability was established through the following efforts:

1. Examination of each maneuver battalion TO&E to determine
    - the number and types of weapons
    - the organization for Class V support in terms of
        - equipment
        - personnel
        - vehicles

2. Examination of the division support command (DISCOM) to determine the ammunition transport, handling, and management capability;

3. Summary of the organization of a typical brigade in terms of total weapons by type and ammunition transport capability by number and type of vehicle;

4. Determination of the typical deployment of an LID with particular attention to the ammunition distribution and the distribution of distances from

- Battalion trains to brigade trains
- Brigade trains to the ammunition transfer point (ATP) if ATPs are available
- Brigade trains to the ammunition supply point(s) (ASPs)

5. Determination of the ammunition transport, handling, and issue capability of the nondivisional direct support units providing Class V support to the light infantry division.

6. Investigation of the sensitivity of the ammunition resupply system to the distance that resupply vehicles travel from the battalion trains to the resupply point.

7. Interface with relevant organizations for interviews with logisticians involved in light infantry division Class V doctrine, force structure, and materiel development requirements generation.

Subtask Number 2

The Class V resupply organization and material of similar organizations, such as a USMC division when deployed (i.e., not in an amphibious assault posture) were examined and compared to similar organizations in the U.S. Army Light Infantry Division. Also, shortcomings and choke points in the resupply system where personnel, current vehicles, or equipment may be insufficient to carry out the mission were identified.

Subtask Number 3

Subtask Number 3 investigated and identified short-term, low-cost, nondevelopmental productivity-enhancing improvements similar to those accomplished under the unit basic load-upload equipment transition-to-war program, which may be applied to the LID and DS support. Applicable requirements for limited, controlled field tests validating baseline and improved system performance were also determined.

Subtask Number 4

An investment strategy for engineering and product improvement and materiel development programs to support the LID mission requirements for AirLand Battle and Army 21 type missions were prepared.

Subtask Number 5

This report summarizes the data developed in Subtasks 1 through 4.

## DISCUSSION

### The LID Mission

The stated mission of the LID is to defeat enemy forces in a "low-intensity" conflict and, when properly augmented, reinforce U.S. forces committed to a "mid-high intensity" conflict. The following definitions are paraphrased:

- Low intensity (A): Actions by U.S. combat forces engaged in operations described in low intensity (B).

- Low intensity (B): Actions by U.S. forces in providing advice, combat support, and combat service support (CSS) to indigenous or allied forces engaged in establishing, regaining, or maintaining control of specific land areas.

- Mid intensity: Modern technology and all resources for limited objectives under definitive policy limitations as to the extent of destructive power that can be used or the extent of the geographical area that might be involved.

- High intensity: Modern technology and all resources with no explicit limitation on objectives.

*(Note. In the development of ammunition requirements discussed later in this report, the terms heavy, moderate, and light levels of intensity of operations are used. The levels of intensity of operations are not to be confused with the levels of conflict that were just defined. Any of the levels of intensity of operations can be experienced in any level of conflict.)*

### The LID Organization

#### Chief of Staff of the Army (CSA) Guidance

The original guidance of the CSA called for the LID to have more combat power relative to its total structure (nine maneuver battalions, which equates to 50% infantry); to be highly deployable (400 to 500 C141B sorties or by ship); to be augmented when used to supplement heavy forces; and to rely on external support. Therefore, the LID must have an austere and innovative system of CSS.

*(Note. The LID was tailored for low-intensity conflict. Requirements for antiarmor and artillery weapons, tanks, and armored personnel carriers were reduced or eliminated. Any subsequent modifications of organizational structure [e.g., a light tank or assault vehicle as addressed by the current CSA] will have a significant impact on Class V resupply.)*

## Structure

Figure 1 depicts the organization of the ID. The actual LIDs, until they are all fully formed, have differing organizational structures. The only difference in the LID structure, at the time of this report, that had any significant impact on this study was the separate 155mm howitzer battery that is organic to the 7th LID's artillery. The development of ammunition requirements for the LID in this study includes the separate 155mm howitzer battery.

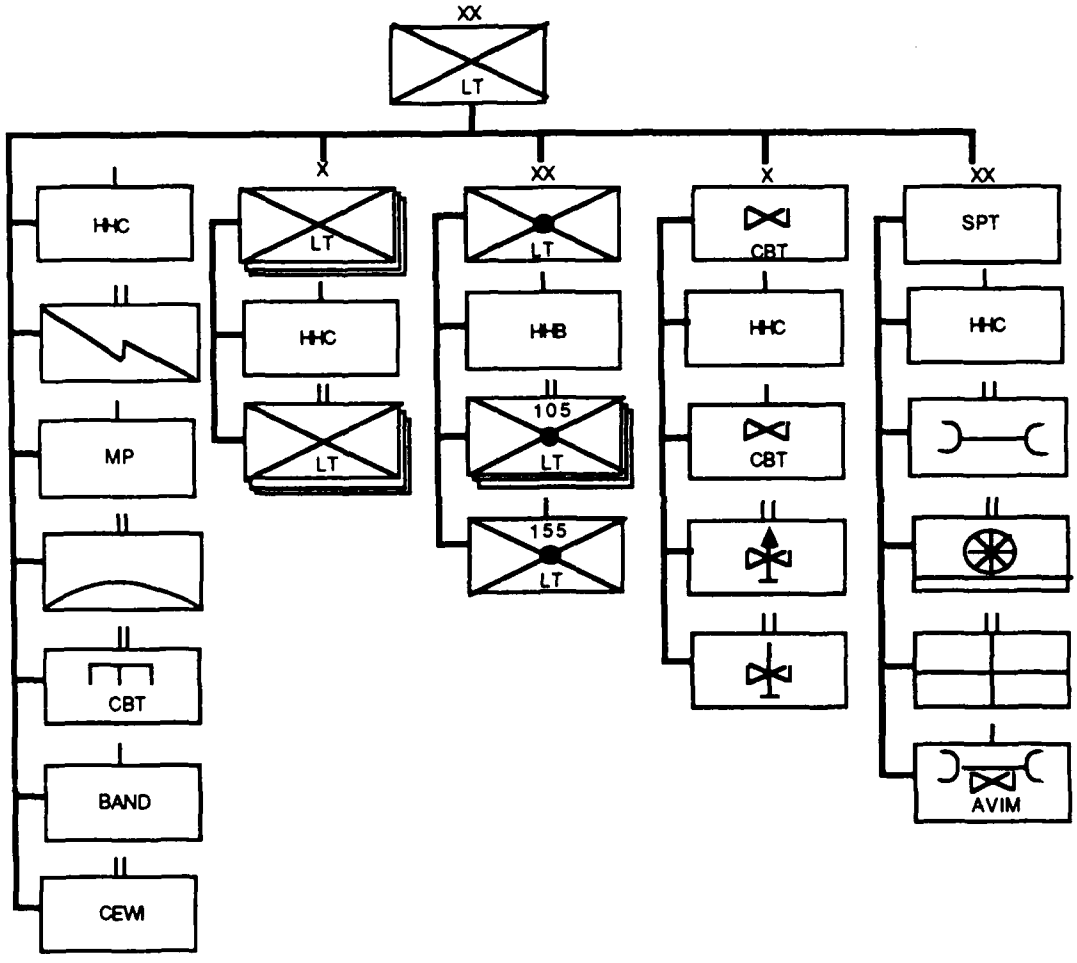



Figure 1. Light infantry division structure.

## LID Augmentation

In accomplishing its assigned mission, the LID requires appropriate augmentation of combat, combat support, and combat service support when assigned to mid- and high-intensity

conflicts. This augmentation will be required when the LID supplements heavy forces in NATO (North Atlantic Treaty Organization), Southwest Asia, and any mid-intensity areas.

## LID Employment

The LID is organized for rapid deployment under multiple employment options. The division may deploy in support of contingency operations into areas where there may not be U.S. or allied bases. Thus, planners in the contingency deployment have to look at the most probable type of operation while retaining the ability to change organization and tailor the force to meet the mission. The population in the contingency area can range from friendly, to neutral, to overtly hostile, to U.S. forces. However, a secure landing field or beach, must be available whether secured by the host nation, other U.S. forces, allied forces, or an irregular force. Local air superiority and tactical air support are essential in all phases of the contingency operation. The division is generally organized into an assault echelon and a follow-on echelon and conducts operations as follows:

### Phase I--Deployment

Operations in contingency areas normally begin with the movement of the division's assault force into the area by air or sea. The deploying force lands on or close to its objectives. It secures its initial objectives to establish and maintain a secure lodgement and to protect it from direct fire and observed indirect fires. These actions facilitate the landing of follow-on forces during the next phase of the operation.

### Phase II--Lodgement

Lodgement begins with the introduction of follow-on forces into the contingency area. Follow-on forces reinforce and support the original deploying force and establish the lodgement. During this phase, sufficient combat power is generated and tactical operations are conducted to fully secure the lodgement area by expanding the security area out to the range of organic indirect fire weapons.

### Phase III--Expansion

Expansion of the logistics base and the buildup of forces begins after the situation in the lodgement area is stabilized. The division performs combat operations from the lodgement area and continues to eliminate threatening enemy forces. Operations of greater distances require a larger base and additional combat, combat support, and combat service support forces.

In addition to contingency operations, the strategic deployability of the division enables it to rapidly reinforce U.S. and allied forces deployed anywhere in the world. Such conflicts can be expected to be at the mid- to high-intensity level. The selection of a preferred employment option or a combination of options is based on the terrain, the type of enemy expected, and the capabilities and limitations of the division. Employment options for the division include

- employing the division as it is organized. In this instance, the division's limited manpower and austere tactical transportation assets, antiarmor, fire

support, and logistic capabilities have been considered, and it has been determined that the division is capable of accomplishing the mission.

• augmenting the division after deployment. Augmenting the division with forward deployed elements or support increases its capability. The division's command and control structure has the capability to accept and quickly integrate these assets into the division's scheme of maneuver.

• augmenting the division before deploying it with units that possess st ategic mobility compatible with that of the division.

• designating selected items of prepositioned heavy equipment in the theater for issue to the division enabling it to assume additional missions.

• tailoring the division to meet theater-specific requirements. This option includes providing subordinate brigades and battalions of the division to forward-deployed divisions for employment in terrain suitable for light infantry. The division is also prepared to accept designated heavy elements and accompanying support to enhance its combat capability.

Regardless of the option selected, upon arrival in a mature theater, the division becomes an integral part of the larger force, normally a corps or joint task force to which it is assigned.

## Army Concept for CSS

Future battlefields pose challenges to the CSS units that must sustain the force. U.S. forces must take advantage of every support asset. This includes taking full advantage of host nation resources through formal agreements and ad hoc measures undertaken during operations, as well as foraging, and the use of captured enemy material.

The CSS force must incorporate the principles of *responsiveness*, *flexibility*, and *initiative*. The fluid situations of future battlefields will require that support unit commanders anticipate needs, not wait to react to demands. CSS commanders must understand supported commanders' operational plans to perform responsively. They must know the CSS requirements of support forces and details of the operational plans and advise commanders of CSS risks in the plans. They must also devise innovative ways to support the plans and lessen the risks.

Effective communications must be maintained between maneuver battalions and the DISCOM to determine the CSS requirements of the division and to coordinate support activities. Priorities for CSS must be established. Depending on the tactical plan, ammunition and bulk fuel resupply, maintenance, personnel replacement, and health services may have highest priority. Close coordination is also necessary to ensure that the units with the highest tactical priority receive their required support first. Effective communications and coordination will enable the DISCOM commander to emphasize the flow of supplies rather than the buildup of stocks. It may be necessary, however, to stock critical supplies near points of anticipated consumption to permit continued operations in case the CSS system is disrupted. Such action, however, must not impede the mobility of the maneuver battalions. Constant and complete coordination is also necessary to ensure effective and integrated transportation support in constantly changing circumstances.

The combat mission of the LID must remain the foremost consideration in the functions of CSS units. Resources and priorities must be tailored to changing combat situations. Maintenance, supply, and other support elements must be far enough forward to be responsive to requirements.

## LID CSS Organization

### Division Support Area (DSA)

A DSA is established as a base of CSS operations for the LID. The DSA is occupied by the DISCOM command post and organic and attached units. The DSA will normally include corps support elements providing support to the LID.

### The DISCOM

The DISCOM is organized to provide the most effective and responsive support to tactical units in a combat environment within prescribed strength limitations (see Figure 2). To provide responsive support to the tactical commander, the logistics, medical, and administrative services must be functionally organized and positioned in the areas requiring support (the DSA and the brigade support area [BSA]).

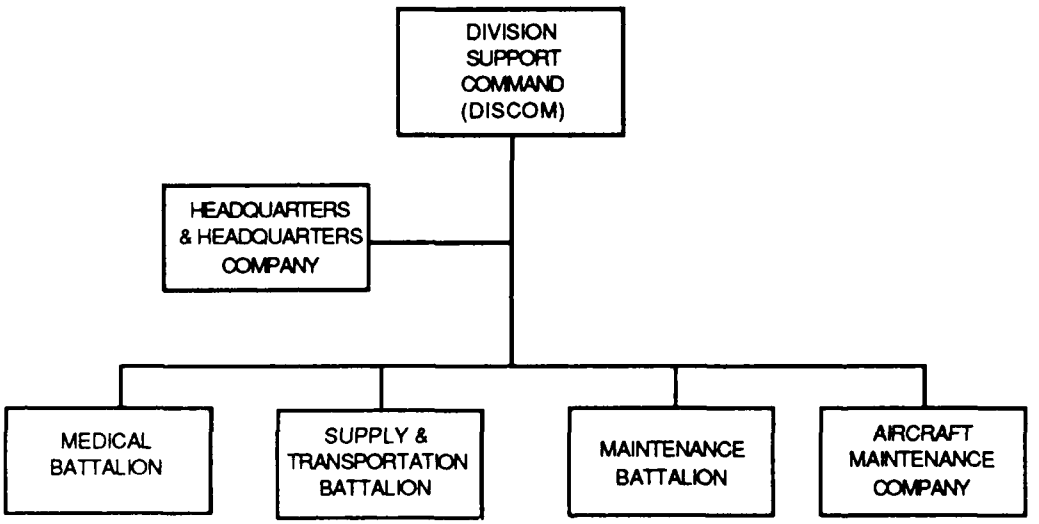



Figure 2. LID DISCOM structure.

The DISCOM mission is to provide division-level CSS (except for construction) to all organic elements of the division. This support consists of

- Requisition, receipt, temporary storage, and distribution of all classes of supply
- Intermediate DS maintenance and back-up unit maintenance support for divisional units
- Division-level health service support
- Water purification and distribution
- A limited capability to transport division reserve supplies
- Clothing exchange, bath, and graves' registration services, each by augmentation of appropriate units in the supply and transport battalion
- Planning, coordinating, and supervising rear battle operations in its assigned areas of responsibilities
- Logistics interface and coordination with allied units when the division is used out of sector or attached to a major NATO or other allied command formation

Selected key functions and responsibilities within the DISCOM and related to Class V resupply include

- The DISCOM Headquarters operating the division ammunition office to plan and control Class V support in coordination with the division G3 and G4
- The division support operations officer coordinating with the Corps Support Command (COSCOM) in bringing about Class V resupply
- The forward area support coordinator (FASCO), operating in the BSA under the command of the DISCOM, coordinating the Class V resupply requirements of the brigade commander
- The division ammunition officer (DAO) is the focal point for the management of Class V within the LID (see the Division subsection in the LID CSS Command and Control section immediately following for specific responsibilities).
- The ATP section in the forward supply company (FSC) of the supply and transportation (S&T) battalion operates the ammunition transfer point located within the BSA. The FASCO coordinates unit pickup schedules at the ATP and ensures smooth operations at the ATP.

## LID CSS Command and Control

### Infantry Brigade

The command and control of CSS operations in the LID begins in the light infantry company. Appropriate actions must take place here if the CSS system is going to provide the right support, in the right place, at the right time. The supported unit commanders must understand what support their units are capable of providing themselves, what actions their units must take to receive external support, and what support they can expect to receive.

CSS command and control information is essential to the decision-making process of CSS planners and operators. Command and control information provides CSS planners and operators with data necessary to effectively employ CSS units.

The company is the lowest administrative and tactical organizational unit with personnel designated to perform CSS functions. In the LID, CSS functions will be coordinated by the company executive officer, the first sergeant, and the supply sergeant in the company headquarters. CSS support at this level will consist of making requirements known and assuring that requirements are met. Supply requests originate at this level.

The next higher organization with CSS personnel is the battalion. The battalion headquarters is basically the support link between the companies and the CSS elements of the DISCOM. The support platoon of the light infantry battalion headquarters company has a transportation section to take supplies to the companies and a supply section that requests and distributes supplies.

In the LID, unit maintenance is consolidated at brigade level. Combat support and separate battalions perform unit maintenance of their organic equipment. Maintenance operations and management is under the staff supervision of the S4.

The battalion executive officer usually supervises battalion CSS through the battalion staff.

The light infantry brigade provides consolidated unit maintenance for vehicles and generators and food service support for assigned infantry units. All other support of the three brigades is provided by units of the DISCOM. This support is coordinated through the FASCO associated with each brigade.

Each FASCO, although part of the DISCOM, is placed in support of a light infantry brigade and provides priority of effort to support required by that brigade. The FASCO plans, coordinates, and supervises the CSS (not including personnel, administration, and religious support) provided to the brigade and other division units in the BSA. The FASCO reports directly to the DISCOM commander.

### Division

It is not considered necessary to repeat all the CSS command and control aspects that have been covered elsewhere in detail. However, since the DAO is the hub of all Class V functions within the division, it is considered appropriate to address the DAO's specific responsibilities:

- Overall control of Class V operations in the division
- Represents the DISCOM commander on matters pertaining to ammunition requirements and availability
- Technical assistance and advice to division units
- Liaison with the division G3 and G4 about ammunition requirements (controlled supply rate [CSR] and usage data)
- Authenticates DA Form 581 (request for issue and turn-in of ammunition) of division units requesting ammunition

• Directs the establishment of, and provides staff supervision of, the division ATPs

• Effects liaison with supporting corps ASPs and the ammunition staff officer corps and above

Corps Support

When a corps support unit is deployed and supports the LID from the DSA, its support mission statement specifies its command relationship with the DISCOM element to which the unit is deployed to support. This statement tells the unit the specific mission the unit is to perform and the element to which it is to report. Such items as individual jobs to perform and work load priorities are normally determined by, and coordinated with, the DISCOM element.

Concept for LID Class V Resupply

Figures 3 and 4 depict the Class V resupply concept for a LID during the initial phase of operations and subsequently during airhead operations with corps support, respectively.

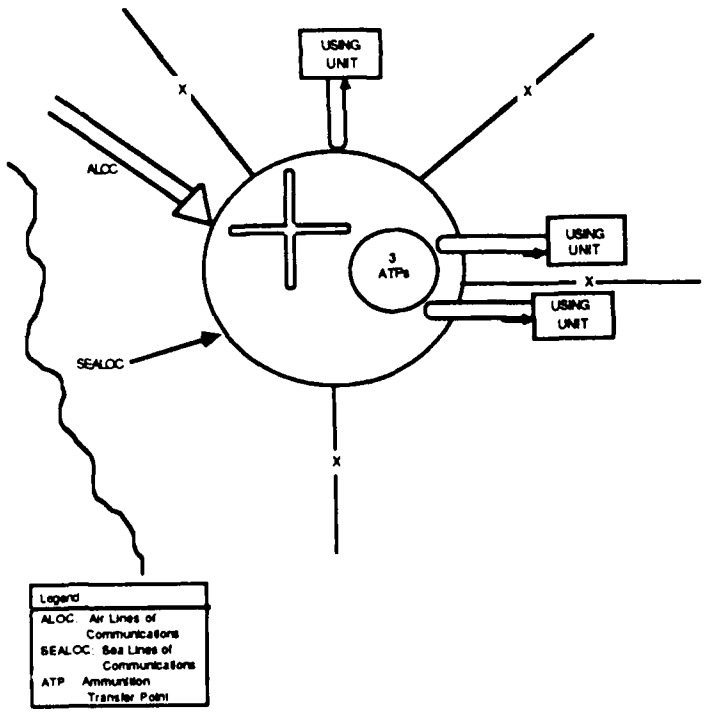



Figure 3. Class V flow (initial phase).

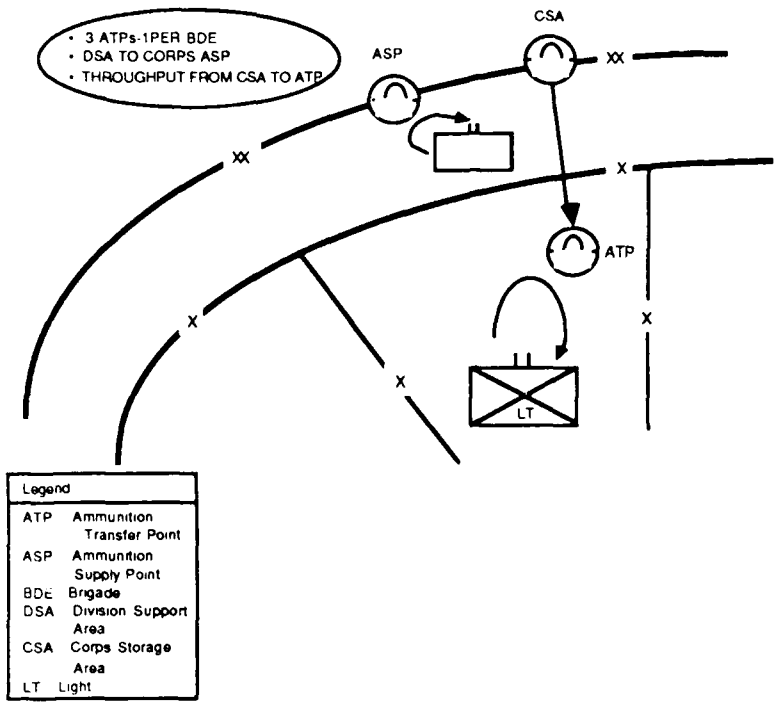



Figure 4. Class V resupply.

Before a corps ASP is established, the division ATPs initially work together at an airhead or port facility. Ammunition will be received and distributed in the same manner as at a corps ASP, though the capacity would not be equal to that of an ASP.

Within a mature theater, ammunition will be throughput to the ATPs using corps transportation. The composition of the shipments can be managed by the DAO using user unit requisitions. This assumes that the DAO will have adequate communications and data management means that are currently not at his disposition.

For high tonnage items, the LID has an ATP to support each BSA. Ammunition is transloaded at the brigade ATP from corps' line haul-transport vehicles to combat unit resupply trucks. Because of the lack of a fourth ATP, units in the DSA will pick up 100% of their requirements from the corps ASP.

In a low-intensity environment, the corps will be required to deliver 100% of the brigade ATP requirements. In mid- to high-intensity situations, low usage items will not be processed through the ATPs but must be picked up by the requesting unit at the corps ASP (see the Distribution of Forces subsection in the Analysis section relating to the distribution concept).

Management of Class V operations is accomplished by the division ammunition office located in the Headquarters and Headquarters Company (HHC), DISCOM, and one ammunition noncommissioned officer (NCO) assigned to each FASCO section.

Figures 5 and 6 depict the Class V resupply concept based on currently published doctrine for low-, mid-, and high-intensity levels of conflict on a conventional battlefield.

After the corps establishes an ASP, an ATP moves with each brigade as it deploys. At this stage, in low-intensity operations, units continue to draw 100% of their Class V from the ATP. If intensity escalates, thereby requiring reinforcement or augmentation of the LID with combat support (CS) or CSS elements, the ATP will normally handle only high usage Class V. In this case, all other Class V is drawn from the corps ASP. Units in the DSA draw Class V from the corps ASP.

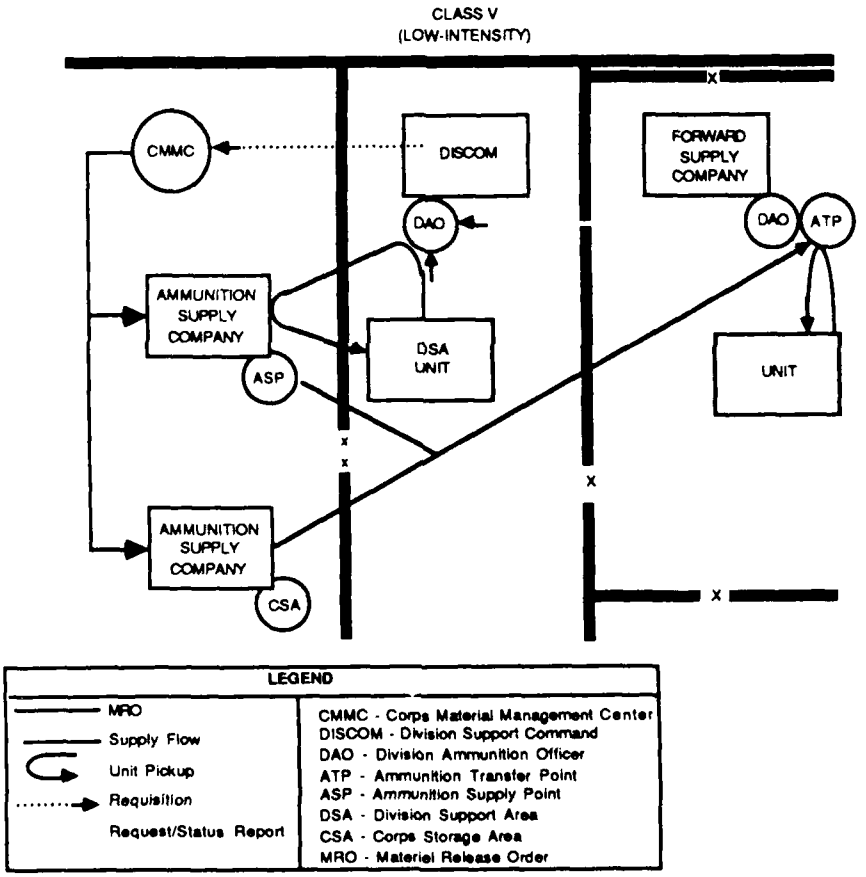



Figure 5. Class V distribution (low-intensity operations, ASP established).

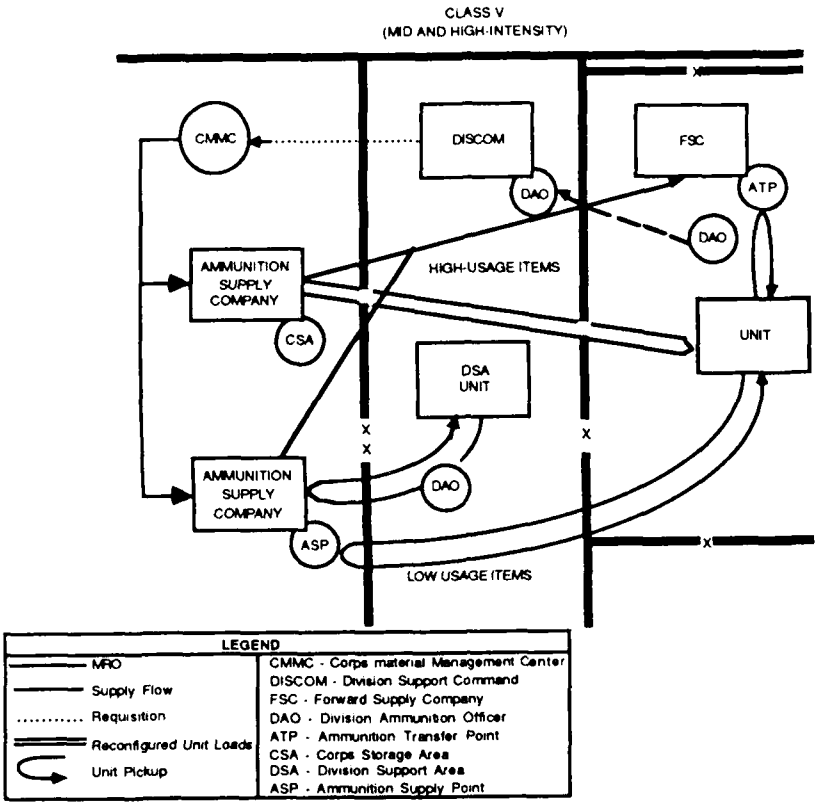



Figure 6. Class V distribution (mid and high intensity, ASP established).

The DAO, located in the DISCOM headquarters, performs ammunition management for the division by authenticating ammunition requests and managing controlled supply rates. The DAO, as the ammunition focal point for the division, also has staff supervision for all ATPs. In conjunction with this responsibility, the DAO will establish procedures for authentication of ammunition requests. Authentication will be accomplished by the ammunition NCO at each ATP or the DAO representative in the DSA before submission to the corps ASP.

Units using ammunition present requests (transportation orders) or DA Forms 581 (request for issue and turn-in of ammunition) to the ammunition NCO or DAO representative for authentication. The normal basis for approval of the requisition is the replacement of expenditure that is within the limits of the CSR. Specific controls are instituted to monitor and fill requests that exceed the CSR. The DAO maintains records of the ammunition issued to each unit and controls the issue of intensively managed ammunition items. The ammunition NCO or DAO representative validates all ammunition requests before they are presented to a COSCOM ASP or a brigade ATP. He keeps issues of ammunition within the announced CSR. The DAO reports Class V items that are in short supply to the COSCOM Materiel Management Center (MMC) and keeps the ATPs informed about supply problems so that appropriate corrective action can be taken at all levels.

Supply point distribution is the primary method of distributing ammunition. In low-intensity operations, the ammunition vehicles of the units using ammunition normally return to the ATPs for ammunition resupply. In certain combat situations, the corps G4 may direct deliveries of selected ammunition items to using units. In emergencies, the transportation motor transport (TMT) company of the DISCOM S&T battalion may provide limited unit distribution of Class V.

One ATP is established in each brigade support area. Brigade ATPs are operated by the forward supply companies of the S&T battalion and are under the staff supervision of the DAO.

Class V supplies are delivered to each ATP on COSCOM S&P semitrailers. Ammunition requests are made by the user battalion logistics officer to the DAO representative at the ATP. The DAO representative releases authorized ammunition assets from the ATP to the using unit and forwards information pertaining to the issue to the DAO. The DAO monitors these daily transactions to make sure they are in accordance with the required supply rate (RSR) and the CSR and forwards item summary data to the Corps MMC (CMMC) so that the appropriate ASP can replenish the issues and maintain authorized levels of ammunition.

The normal flow of ammunition into the ATP will be by throughput from the CSA on the corps S&P trailers. In an emergency, the DISCOM S&T battalion may provide back-up transport capability.

The COSCOM ASP can, in emergency situations, maintain ready-to-go S&Ps loaded with high-usage items for issue to the ATPs. The types of ammunition and the number of S&Ps to be kept in a ready condition will be based on coordination among the ASP, the DAO, and the corps movement control center.

Supplying missile ammunition for weapon systems is a responsibility of the conventional ammunition support structure and includes TOW, Dragon, and Stinger systems. The logistics actions to supply missile ammunition for division consumers include the basic functions common to all types of ammunition: requisition, issue, receipt, distribution, storage, maintenance, surveillance, security, disposal, and safety. The division is concerned with only those missile supplies in the conventional ammunition support structure.

The corps may also stock a limited number of preconfigured unit loads (PULs) of Class V. The PULs, which would be in company- and platoon-sized packages, would be deliverable by UH-60 helicopters to satisfy current battle requirements when normal Class V resupply is not possible.

### Class V Information and Data Flow

Figure 7 depicts the information and data flow requirements necessary for the effective and efficient command and control of Class V resupply operations. The DAO, as the focal point of this system has the requirement to effect coordination with no fewer than 17 organizations.

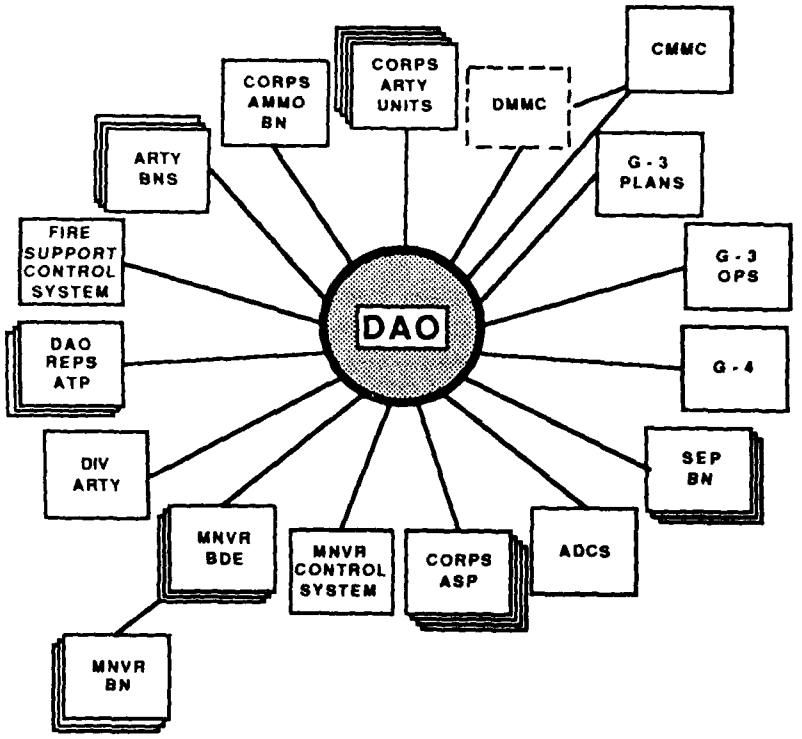



Figure 7. Division ammunition logistics information requirements.

Communications and Automation

The complex system of communications and automation required to support ammunition logistics is only one aspect of an even more sophisticated system required for the total CSS system. The Army recognizes the shortcomings of the system and has been working for several years on developing and implementing an adequate communications and automation system. Significant advances have been made. However, in the automation and communications for LID ammunition logistics, there are deficiencies that can be remedied in the short term and still retain compatibility with long term hardware and concepts that will be implemented for the total CSS system. Specific LID system deficiencies and "fixes" were identified during this study and are addressed in the Visit Results subsection and the Conclusions and Recommendations and Investment Strategy sections.

Successful LID CSS

The U.S. Army Logistics Center (LOGCEN) has identified factors that are important to successful CSS for the LID. Those of critical importance to Class V resupply are

a. Transportation--The effective and efficient use of transportation assets is basic to any resupply function. LID units, by design, have meager transportation assets and are severely limited in their ability to perform routine Class V resupply functions.

b. Preconfigured unit loads and unit configured loads--PULs are intended to be wholesale configured in the continental United States (CONUS) by specific function and are to include several items under one national stock number (NSN). Different types of PULs were evaluated during the LID certification; however, Class V was not included. Distribution is intended to be accomplished from the Corps storage area down through various echelons to include the user battalions.

Unit configured loads (UCLs) would be comprised of more than one class of supply as configured by the Corps Support Command for the needs of specific units. Resupply concepts currently being tested and validated through the use of such items as the palletized loading system would enhance the UCL concept.

Concepts such as the PUL and the UCL, if intended for Class V resupply on a dynamic battlefield, would require a capability to rapidly make adjustments in the composition of the PUL and UCL to effectively and efficiently support combat units in an accurate and timely fashion. The means to manage the information and data required to make such adjustments in a timely and accurate manner do not currently exist in the Army's Class V resupply system. This is not to say that the means will not exist some time in the future.

c. Maximum throughput--The LID CSS concept depends on maximum throughput; however, two essential requirements for maximum throughput are adequate transportation assets and a command and control system. To enhance the "deployability" of the LID, it was designed to have austere transportation assets. Secondly, as discussed earlier, the LID's Class V resupply system has deficiencies in communications and automated data management capabilities. (Further detailed discussions are provided in the following section on Host Nation Support.)

Host Nation Support (HNS)

The U.S. Army Logistics Center defines HNS as any situation when the United States agrees on support arrangements with an allied nation in whose territory U.S. forces will be operating in war.

The U.S. Army Training and Doctrine Command (TRADOC) Pamphlet (PAM) 525-36 (1984) specifies that the concept of HNS applies only to wartime HNS; control and maintenance of U.S. nuclear and chemical ammunition are *not* performed by HNS, and combat operations are not conducted under HNS agreements except for rear area combat operations (RACO) in the communications zone (COMMZ).

TRADOC PAM 525-36 (1984) further describes the operational concept characteristics as follows: It allows flexibility; it prefers formal agreements; it can be used in combat zones to the COMMZ; and it uses civil affairs personnel to assist and coordinate HNS efforts. In some cases language-proficient personnel are required to provide the interface between the U.S. Army and HNS elements. When it comes to contingency operations, those people designated to coordinate HNS must be among the early arrivals into the contingency area. U.S. personnel must be trained in the employment and management of HNS. HNS personnel must be trained, especially in the areas of NBC (nuclear, biological, and chemical) defense considerations and the operations required of them. Last, but surely not least, is the force structure implications. Adjustments of force structure based on HNS are not made before acceptable documentation is completed indicating that support is reasonably assured. There may also be new organizational designs required. U.S. technical coordination and documentation teams will be required to augment HNS. Control and technical activities must be tailored to facilitate U.S. accountability and documentation with HNS.

Heavy reliance is placed on HNS in the area of ammunition logistics. Historically, HNS has been used to great advantage. The future success of this operational concept will depend on the willingness of allied nations to provide this support and the readiness of organizations charged with implementing HNS. Since HNS is critical to Class V resupply, its planned use should be evaluated critically in each specific case.

## U.S. Marine Corps Operations

### Objective

The objective of this portion of the study is to examine the Marine Division as a ground combat organization.

The purpose of the examination is to identify the Marine Division combat service support capability, with particular reference to Class V resupply, personnel, equipment, and transportation resources.

### Operational Precept

The Class V resupply examination of the LID must be addressed in the context of a fundamental operational precept: "Light" as in light infantry division, must be logistically expressed in varying degrees of "heavy."

A commitment of the LID is predicated upon a swift application of fire and maneuver, in which the constraints of individual load, equipment and supply lift, and on-site delivery, are minimized. The LID combat capability, however, must use some form of a task-organized CSS process, in Class V alone, within the first battle day of a given operation.

### Combat Service Support Functions

It is with this operational capability paramount in mind that the CSS functions of the Marine Corps are examined and evaluated for LID consideration.

The Marine Division, committed as one of three force levels, launches its assault from a position of 0% tactical advantage. Although the organic resources of the two divisions can be roughly comparable before commitment, the CSS divergence between the LID and a Marine Division becomes extreme at commitment.

The LID could be committed as a division without augmentation. The Marine Division is committed only in a task-organized force structure. The task organization is in direct response to the threat involved and the time or distance constraints imposed.

### The Fleet Marine Forces

The Marine Air and Ground Task Force (MAGTF) structure of air and ground firepower is tailored exclusively to the threat force. It is overmanned and up-gunned to offset the initial lack of tactical advantage and to absorb the casualty losses normally sustained in such operations.

The MAGTF uses a PUSH logistics support train of attached CSS units which, from amphibious shipping offshore, debarks and moves inland in a scheduled procedure, and in response to the given tactical situation.

Two senior operating force commands exist regionally; the eastern theater of operation is the Fleet Marine Force FLANT (FMFLANT) in Norfolk, Virginia, and the western theater of operations is the Fleet Marine Force Pacific (FMFPAC) in Hawaii. From the respective jurisdictions of these two commands, the designated landing forces are organized, tasked, and dispatched.

The FMFPAC and FMFLANT are not mirror imaged (see Figures 8 and 9). FMFPAC addresses the entire Pacific basin as an operating area, and therefore, contains two divisions, wings, and service support groups. Conversely, FMFLANT has only one of each major organization addressing the Atlantic, the Caribbean, and the Mediterranean theaters of operation.

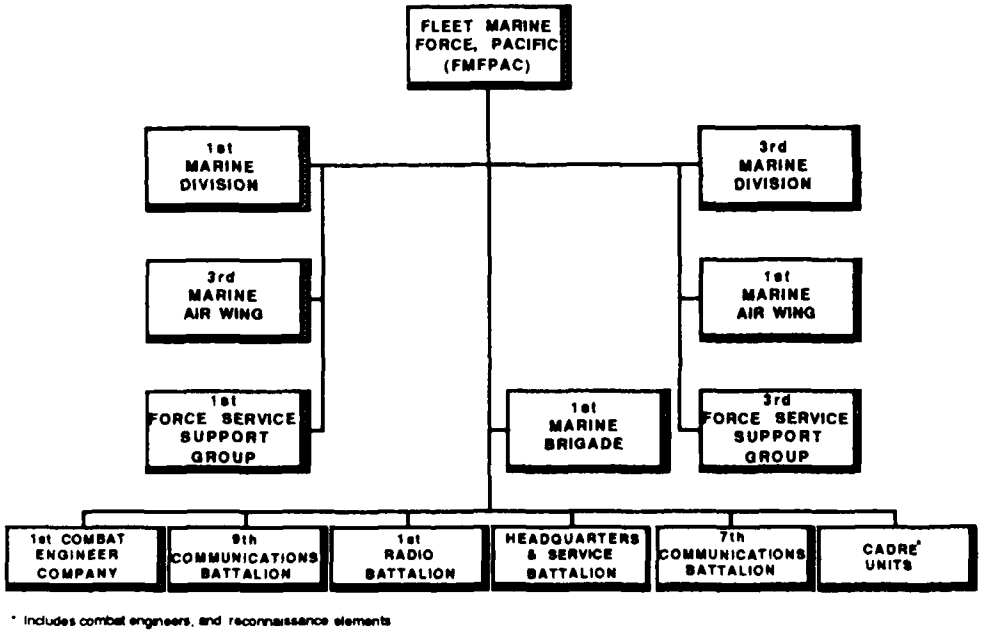



Figure 8. Fleet marine force, Pacific.

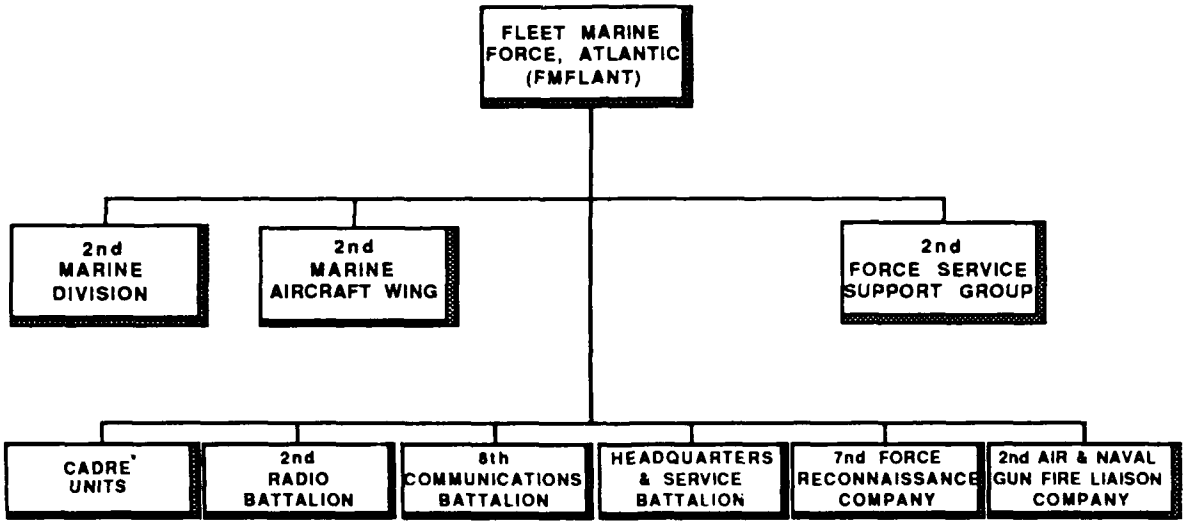



Figure 9. Fleet marine force, Atlantic.

Finally, it must be understood that elements of either major operating command--FMFLANT or FMFPAC--can be detached and assigned to the operating and administrative control of the other major operating command. This does not mean that the assets of the one command would be adversely reduced to impair the ground combat, the air combat, or the service support capability of that command.

FMFLANT and FMFPAC are colocated with the command headquarters of the naval offices--Commander in Chief, Atlantic Fleet (CINCLANTFLT) and Commander in Chief, Pacific Fleet (CINCPACFLT). This facilitates the planning and execution of given amphibious operations.

## Missions

### Overall Mission

As defined in Field Manual (FM) 7-4, USMC Doctrinal Publications Guide, the overall mission of the U.S. Marine Corps is to provide fleet marine forces (FMF) with which to conduct amphibious operations worldwide either as a joint task force or within a joint service operation. Their mission also includes conducting littoral operations in support of land warfare by a larger force. and conducting special operations worldwide, unilaterally, or in conjunction with other forces.

The special missions, as derived from the overall mission, are

- to serve with the fleet in the seizure and defense of advanced naval bases and in the conduct of such land operations as may be essential to execute a naval campaign;

- to develop, as directed by the Commandant of the Marine Corps, the doctrines, tactics, techniques, and equipment used by landing forces in amphibious operations;

- to train and equip Marine forces for airborne operations as directed by the Commandant of the Marine Corps;

- to train a maximum number of personnel to meet the requirements of expansion in time of war; and

- to perform such other duties as may be directed.

The Marine Air and Ground Task Force

The principal characteristic of the MAGTF, the operating force of the FMF, is specific tailoring of the combat, combat support, and the combat service support elements into the precise size and composition required to meet the identified threat. The singular aspects of the MAGTF are the air and ground combat elements with which to project offensive power and force ashore.

Functions and roles that the MAGTF can perform include

- peaceful power projection
- show of force in a crisis
- early commitment to combat
- preserve national options
- assist allies
- provide humanitarian assistance
- support disaster relief
- protect installations
- protect or evacuate noncombatants

The principal elements of each MAGTF are a *ground* and an *air* element. These two elements include direct and indirect fire, small and large caliber, and ground fire support weapons, as well as attack and support aircraft which, at the MEB (Marine expeditionary brigade) and MEF (Marine expeditionary force) levels, can provide both fixed wing, high performance, and rotary wing attack and support aircraft. As a corollary to the LID structure, the structure of the Marine Division is depicted in Figure 10.

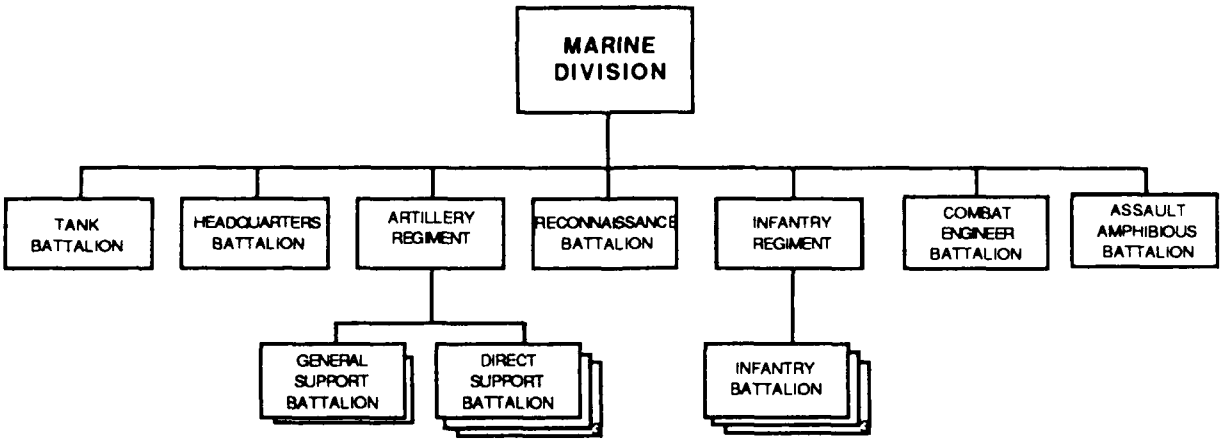



Figure 10. Marine division structure.

Within its internal structure, the infantry battalion can augment rifle companies with mortar, antitank, and flame support for the route, the approach, or the tactical march. The offensive and defensive roles of the division will directly influence the augmentation structure down to and including the rifle platoon. In various instances, the attachments may also reflect an imbalanced distribution of firepower for the rifle company or companies "according to the situation and the terrain."

The tank battalion, as a combat organization, is never committed as a battalion. Amphibious operations use tanks primarily as firepower in contrast to land warfare, in which tanks are used primarily for shock effect (i.e., tank infantry operations in which the infantry are dismounted in amphibious operations versus the armored infantry assault in which the infantry are mounted in assault vehicles in land warfare). Companies or platoons of tanks are attached to infantry organizations from the time the MAGTF embark on amphibious ships until assault waves disembark from the amphibious task force and until rear areas are established within the beachhead objective area in which parent organizations can resume "normal" housekeeping. Thereafter, every tank operation is conducted in support of a given infantry organization.

The artillery regiment can support the entire division on a broad front and contains both general and direct support firing battalions. The three direct support battalions (towed 155mm howitzers) and the two general support battalions (self-propelled 155mm and 8-inch howitzers) support infantry operations in coordination with combat air support for appropriate firepower applications. The artillery battalions and the firing batteries can also be deployed with the infantry regiment and battalion, respectively, within the MAGTF structure.

The assault amphibious battalion provides the entire assault wave surface lift capability in a single lift from amphibious shipping to inland objectives, if required. A limited capacity in mine clearance and direct fire support is presently undergoing development. In part, the assault wave of the amphibious operation can be directly compared with the armored infantry concept in troop lift considerations. With the current addition of the light armored vehicle (LAV) organizations, the MAGTF will increase its operational capability to support land army operations in littoral regions worldwide.

In each and every force commitment, the MAGTF organization is tailored exclusively to the *specific* threat and *regional* circumstance. The range of organizational structures for such tailored commitment include (see Figure 11)

- the Marine expeditionary unit (MEU),
- the Marine expeditionary brigade (MEB), and
- the Marine expeditionary force (MEF).

It must be further recognized that both the ground and the air elements of the MAGTF have a common command element and a combat service support element. Thereby, the MAGTF incorporates command and control, shock, and sustaining power within its composition for combat commitment (see Tables 1, 2, and 3).

Finally, in the overview, it should be recognized that the MAGTF comprises the "landing force" element of the joint task force (JTF) in an amphibious operation launched from the sea with naval amphibious ship support. If a MAGTF should be committed to a *special operation* and delivered to an airhead with transport aircraft, then the naval portion of a JTF may not be involved. In either scenario, the landing force may well provide the beachhead through which a land army passes in an extended land warfare commitment.

The MEU, MEB, or MEF are deactivated and the elements are returned to their parent commands in either FMFLANT or FMFPAC upon completion of an operation.

### The LID Versus the MEB

This task examines the structure of the Marine expeditionary brigade, a force roughly comparable in numbers to the LID but organized with a CSS component in which Class V is an integral portion of the support mechanism. From this examination, certain considerations can be made regarding LID organization and operational capabilities.

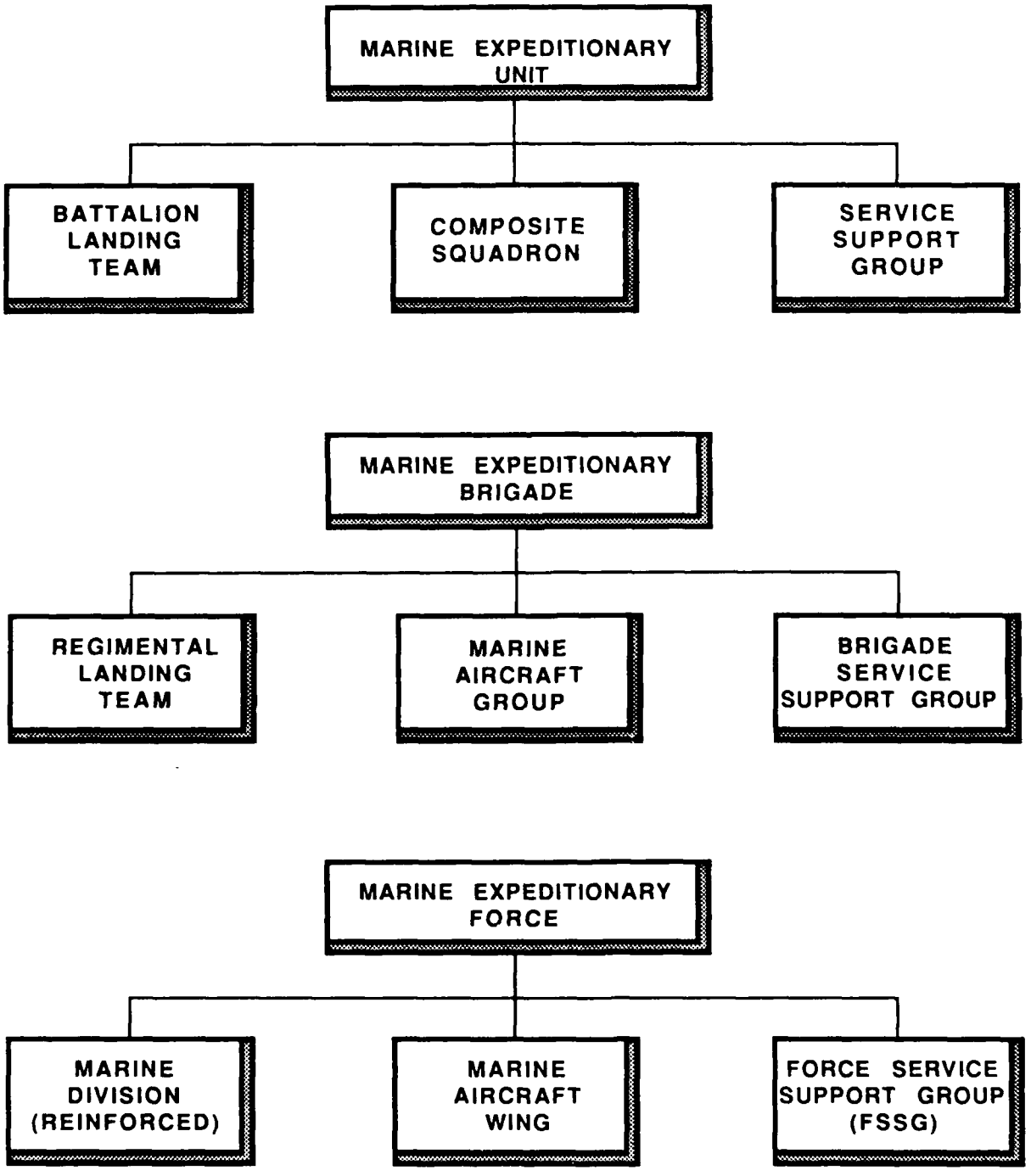



Figure 11. The Marine air and ground task force.

Table 1

The Marine Expeditionary Unit (MEU)

| | |
|---|---|
| **GROUND COMBAT ELEMENT (Battalion Landing Team) - INFANTRY BATTALION (REIN)** | |
| 5 | M60A1 main battle tanks |
| 12 | Assault amphibian vehicles |
| 8 | 155mm, M198 towed howitzers |
| 32 | Dragon missile launchers |
| 8 | TOW missile launchers |
| 8 | 81mm mortars |
| 9 | 60mm mortars |
| 26 | Mk19, 40mm grenade launchers |
| 60 | M60, 7.62mm machine guns |
| **AVIATION COMBAT ELEMENT (Composite Squadron) - HELICOPTER SQUADRON (REIN)** | |
| 4 | CH53D/E heavy lift helicopters |
| 12 | CH46D medium lift helicopters |
| 2 | UH1E utility helicopters |
| 4 | AH1 attack helicopters |
| 6 | AV8B VSTOL Harrier aircraft |
| 5 | Stinger surface-to-air missile teams |
| **SUPPORT ELEMENT - MEU SERVICE SUPPORT GROUP** | |
| | Service support elements |
| | 15 days of supplies |

Table 2

The Marine Expeditionary Brigade (MEB)

| | |
|---|---|
| GROUND COMBAT ELEMENT (Regimental Landing Team) - 2 to 5 INFANTRY BATTALIONS (REIN) | |
| 17 | M60A1 main battle tanks |
| 47 | Assault amphibian vehicles |
| 36 | Light assault vehicles |
| 30 | 155mm, M109 tracked howitzers |
| 6 | 203mm, M110A2 self-propelled howitzers |
| 96 | Dragon missile launchers |
| 48 | TOW missile launchers |
| 24 | 81mm mortars |
| 27 | 60mm mortars |
| 114 | Mk19, 40mm grenade launchers |
| 255 | M60, 7.62mm machine guns |
| AVIATION COMBAT ELEMENT (Provisional Marine Aircraft Group) - HELICOPTER GROUP (REIN) | |
| 20 | AV8B VSTOL Harrier aircraft or 19 A4M attack aircraft |
| 24 | F/A18 or 24 F4 attack aircraft |
| 10 | A6B attack aircraft |
| 4 | EA6B attack aircraft |
| 4 | RF4B reconnaissance aircraft |
| 5 | OA4M specialist aircraft |
| 6 | KC130 refueler aircraft |
| 6 | OV10 assault aircraft |
| 8 | CH53E heavy lift helicopters |
| 20 | CH53D heavy lift helicopters |
| 48 | CH46E medium lift helicopters |
| 12 | UH1 utility helicopters |
| 12 | AH1 attack helicopters |
| 6 | HAWK missile launchers |
| 15 | Stinger surface-to-air missile teams |
| SUPPORT ELEMENT - BRIGADE SERVICE SUPPORT GROUP | |
| | Service support elements |
| | 30 days of supplies |

Table 3

The Marine Expeditionary Force (MEF)

| | |
|---|---|
| **GROUND COMBAT ELEMENT - MARINE DIVISION (REIN)** | |
| 70 | M60A1 main battle tanks |
| 208 | Assault amphibian vehicles |
| 147 | Light assault vehicles |
| 90 | 155mm, M198 towed howitzers |
| 18 | 155mm, M109, self-propelled howitzers |
| 288 | Dragon missile launchers |
| 144 | TOW missile launchers |
| 72 | 81mm mortars |
| 81 | 60mm mortars |
| 345 | Mk19, 40mm grenade launchers |
| 601 | M60, 7.62mm machine guns |
| **AVIATION COMBAT ELEMENT - MARINE AIR WING (REIN)** | |
| 40 | AV8B VSTOL Harrier aircraft or 38 A4M attack aircraft |
| 48 | F/A18 or 48 F4E attack aircraft |
| 20 | A6B and EA6B attack aircraft |
| 9 | TA4/OA4 observation aircraft |
| 8 | RF4B reconnaissance aircraft |
| 12 | KC130 transport aircraft |
| 12 | OV10 observation aircraft |
| 16 | CH53E heavy lift helicopters |
| 32 | CH53D heavy lift helicopters |
| 60 | CH46D medium lift helicopters |
| 24 | UH1 utility helicopters |
| 24 | AH1 attack helicopters |
| 24 | HAWK missile launchers |
| 75 | Stinger surface-to-air missile teams |
| **SUPPORT ELEMENT - FORCE SERVICE SUPPORT GROUP** | |
| | Service support units |
| | 30 days of supplies |

Combat Service Support

The CSS elements that are incorporated within the MAGTF structure of the MEB include supply, service, transportation, and aviation support. Recognizing that, the MEB may include from two to five infantry battalions plus a Marine air group (MAG) of both high performance and rotary wing aircraft and the brigade service support group (BSSG) reflecting up to 30 days of replenishment and service.

The ammunition company of a supply battalion of the FSSG will provide a detachment of men and equipment in direct proportion to the fighting elements of the MEB. In this regard, the PUSH concept will provide men and transport to bring ashore Class V supplies to the designated beach support area (BSA) and forward to the landing zone support areas (LZSAs) established within the MEB operational area.

*(Note. BSA in the Marine Corps context is the beach support area versus the Army context of brigade support area.)*

All aspects of the support capability for the MEB are addressed herein. With the exception of a truck company, no internal Marine division assets are required for the critical resupply requirement.

• Transportation--the lift capability for the MEB reflects both air and ground capabilities.

The truck company of the headquarters battalion in the Marine division is the baseline lift capability for Class V requirements and is reinforced by the motor transport battalion of the FSSG in appropriate numbers for the specific MEB operation.

The need for resupply support without road access is provided through detachments of the medium and heavy lift helicopter squadrons of the MAG in sorties each day as well as aircraft allocations for specified time periods to handle peak load requirements either in resupply or in evacuating both material and medical.

• Material-Handling Equipment--the material-handling platoon of the landing support battalion of FSSG provides the total support requirement for the supplies of the MEB.

• Special Equipment--FSSG organizations are a direct reflection of the specific tactical requirement for CSS.

A detachment of the bulk fuel company of the engineer support battalion of FSSG provide storage and distribution of Class III and IIIA (aviation) bulk fuel to include ground and air transportation.

Subject to the specific operational requirement, the bridge company of the same FSSG battalion provides both fixed and floating bridge support requirements.

Should the nature of the mission and the time and distance factors dictate, the maintenance battalion of FSSG can provide ordnance, engineer, motor transport, electronics, and general (overflow) support at the intermediate level.

• Containerization--The packaging, packing, and preservation of equipment and supplies are an FSSG function. The supply company of the supply battalion of FSSG provides for appropriate containerization, palletizing, special handling, and associated preparation when in garrison. Upon commitment within the MEB structure, elements of the company will operate and maintain a depot activity within the BSA to receive, store, and assist in distribution.

## Visit Results

### Transportation

There is one critical aspect that must be noted in addressing ammunition transportation capabilities of LID units; most units have a significant shortfall in their capability to transport organic equipment and haul ammunition basic loads. Current TRADOC TO&Es address the unit's capabilities to transport TO&E equipment and the unit basic load of Class V supplies. Most units are incapable of transporting their TO&E equipment and Class V basic loads. To illustrate the point, the light infantry battalion (TO&E 77042L000) can transport only 72% of its TO&E equipment and none of its bulk-loaded Class V basic load. The light infantry battalion must rely on the corps to haul its bulk-loaded Class V basic load. There are units in the LID with even greater shortfalls in transportation capabilities. Additional findings relative to transportation include the following:

#### Ground

a. Not all loads (packages) to be transported by the HMMWV fit between the wheel wells. The TOW and the AT4 packages are oversized for HMMWV loading.

b. Vehicles lack cargo tie-down capabilities such as lay-flat rings for the HMMWV.

c. Artillery personnel prefer the 5-ton or 2-1/2-ton truck to the HMMWV as the prime mover for the 105mm howitzer because of total load requirements. The 105mm howitzer battery cannot move as a battery and conduct concurrent resupply operations. Artillery commanders in some units, because of inadequate transportation, intend to overload vehicles to the maximum capacity when moving. Maximum capacity, in this case, was defined as the amount of weight (100% overload) that the vehicle will take and still operate (move).

Based on the requirements of the 105mm howitzer battery, two additional HMMWVs with trailers were tentatively added to the battery's authorization of six (prime movers). Division artillery staff officers indicated that the additional allowance of two is being reduced to one. The requirements for the transportation of the howitzer crew and their equipment, section equipment, and the basic load of ammunition cannot be met with only seven HMMWVs in the 105mm howitzer battery.

d. In airhead type operations, the U.S. Air Force is responsible for delivering supplies to the airhead. The U.S. Army is responsible for moving the supplies from the airhead to a storage area. LID resupply operations cannot be conducted from the airhead directly to the user. In the case of ammunition, the concept calls for distribution from the airhead to ATPs. LID subordinate unit commanders contend that they cannot conduct such operations without a "corps slice." In the absence of corps support, the intent is to clear ammunition from the airhead to a "mini ASP." Based on experience gained during exercises, LID

subordinate unit commanders further contend that they will not be able to effectively clear the airhead without drop-side 5-ton trucks and S&P tractor trailers.

e. All 5-ton trucks dedicated to Class V resupply do not have drop sides.

f. Limited quantities of transportation and driver assets, coupled with the anticipated distances from the user to the ASP will severely limit, or even preclude, the users' ability to conduct resupply operations between their positions and the ASP.

g. A 5-ton tractor is assigned to each ATP section for use in ammunition transfer operations at the ATP. Actual practice precludes the exclusive use of the tractor at the ATP. It is used wherever it is most critically needed in the BSA.

h. The M915 tractor trailer is a hard surface vehicle. Operations in forward areas, in open terrain, or on cross-country roads are impractical.

i. The DISCOM has no TO&E authorization for vehicles to haul forklift trucks. Movement within CONUS is accomplished with commercial equipment transporters.

j. The S&T battalion has no ammunition transportation mission; however, the battalions' organic vehicles are used to transport ammunition in emergency situations.

k. The support platoon leader of an artillery battalion controls six 5-ton trucks with trailers for ammunition resupply. The battery does not have sufficient vehicles or MHE to transload the ammunition and the tendency of battery commanders is to retain the loaded vehicles in the battery position rather than put the ammunition on the ground. In an attempt to eliminate this practice by battery commanders, the support platoon leader releases only a partial resupply load (e.g., one of two vehicles). He releases the remainder of the load only when the empty vehicle has returned from the first partial delivery to the firing battery.

l. Based on interviews with LID personnel, the size of the PLS, with currently planned tonnage capacities (8 tons and 16 tons), is considered too large for applications within the LID. A lesser capacity PLS (e.g., 5 tons), and therefore a smaller overall system, would have application to enhance all classes of resupply within the LID under the MOADS concept especially for ammunition in units with anticipated high tonnages of expenditures.

Air

a. The planned use of helicopters for resupply operations differs among the LIDs visited. One extreme is to use helicopters for maneuver and evacuation operations only. The other extreme is to use helicopters for routine (planned) resupply operations. The "middle-of-the-road" approach, which appears to be the most prudent, is to let the situation determine the use of helicopters with plans to use them for emergency ammunition resupply as a priority.

b. If forced into a situation that dictates the use of the helicopter for resupply operations from an airhead with no other external support, key personnel from one LID indicated that their plans included helicopter resupply in conjunction with surface resupply operations. It was estimated that, with the allocated helicopter assets, the LID could

probably support two brigades for a limited period of time (unspecified) over short distances. It would require augmentation with ground transportation on good ground lines of communications (LOCs).

c. LID units conduct day and night training in helicopter resupply operations.

### Handling and Storage

#### Vehicle MHE

Vehicles dedicated to Class V resupply in the LID are extremely limited in numbers. The effective and efficient use of transportation assets requires that LID units minimize the time required to load, efficiently transport, and off-load ammunition. LID vehicles have no on-board MHE. Suggestions from LID personnel included

a. Five-ton trucks selectively fitted with hydraulic tailgates would aid in handling heavy loads.

b. Five-ton trucks selectively fitted with a crane or "cherry picker" would significantly enhance the loading and off-loading of ammunition at various nodes in the system.

#### Other MHE

a. Personnel in all units with high tonnage cargo-handling missions indicated MHE is insufficient to effectively and efficiently accomplish their missions. Too much reliance is placed on "troop labor" by troops who have other duties.

b. When this study was initiated, LID personnel expressed their dissatisfaction with the International Harvester (IH) 10,000-pound (10-K) forklift truck. The IH 10 K is not air-transportable without some disassembly that requires the use of a crane to reassemble it in the objective area. It should be noted that an air-transportable 10-K forklift has recently been authorized for issue to the LIDs, replacing the IH 10 K and some of the 6 Ks on a one-for-one basis.

c. The employment of the PLS is not the total solution to the user's ammunition handling problems. The loading and unloading of PLS pallets require an MHE capability. This is especially true in units that have a high tonnage of ammunition expenditures (e.g., artillery units).

d. Frequently, the loading and unloading of user vehicles require the "breaking" of pallets and the subsequent loading and unloading of individual boxes or rounds.

e. Personnel in units with an ammunition handling mission and in units with anticipated high tonnage expenditures reacted positively during discussions on the characteristics and capabilities of unit basic load-upload equipment.

f. DISCOM personnel, based on field exercises and unit training experience, indicated that they lack sufficient quantities of pallets and slings to conduct effective training and to efficiently accomplish resupply functions in the field.

## ATP Operations

This section on ATP operations addresses handling and storage. (See the following Personnel and Communications and Accountability subsections for findings relating to other aspects of ATP operations.)

a. The ATP is authorized seven forklifts by TO&E. During field exercises, the forklifts are used to do other cargo handling jobs at other locations, usually within the BSA. The ATP transload planning factor is 250 S/T of ammunition per day. BSA personnel have indicated that there are insufficient forklifts to handle cargo within the BSA. If this situation exists in an actual combat environment, BSA personnel anticipate difficulty, if not failure, in transloading the required tonnage of 250 S/T per day. This will impact heavily on the efficient and effective support required by the user.

b. Personnel with extensive experience in ATP operations indicated that they have seen sectional ramps with rollers and powered conveyor belts used to great advantage in ATP and similar ammunition transloading environments. In a fluid tactical situation, such equipment would greatly reduce displacement times for the ATP and artillery units. The sectional ramps with rollers could be handled easily and transported on the vehicles that are used to transport the ammunition.

## Packaging

The following findings relate to the impact of packaging on ammunition handling:

a. The current method of ammunition packaging is a logistician's solution to wholesale distribution. It is archaic and does very little to ease the burden of the user (field commander) in meeting his requirements for a more user-friendly, retail package. The packaging is bulky, heavy, and requires labor-intensive operations to reduce the ammunition to usable "ready rounds." To compound the problem, the packaging results in costly waste that often represents 30% to 50% of the original weight and bulk of the wholesale package. Disposal is the burden of the user. This has been a dilemma for all Army divisions; however, considering the Spartan nature of the LID, the situation presents a more difficult problem for the LID.

b. Infantry unit commanders rely on the soldier to carry mortar ammunition. The practice is to designate specific individuals to carry one round of ammunition in addition to an already overwhelming individual load. The packaging of 81mm mortar rounds in two-round units does not fall in line with the infantry commanders' practice of one round per soldier. One-round packages are preferred.

## Storage

a. The current procedure of retaining ammunition on corps vehicles at the ATP for a 6-hour period is impractical from two standpoints. Corps vehicles are "tied up," and therefore, ineffective for 6 hours. When considering the number of ATPs and the number of vehicles per convoy, the paralyzing effect on the system is evident. Second, assuming that the tactical situation or an inadequate command and control system prevents the user from arriving at the ATP within 6 hours of arrival of the corps vehicles, a time- and labor-consuming effort could result in "zero" productivity and the failure of the system to support the user.

b. Storage carries the responsibilities of inventory and accountability. On a static battlefield, the requirement to support the user in an accurate and timely fashion is difficult, if not impossible, with the current methods of inventory and control. The concepts postulated under the AirLand Battle will present a constantly changing situation. Responsive support from a recently displaced ATP can be achieved only if the ATP is equipped to rapidly and accurately determine the types, quantities, and specific locations of user needs commensurate with the ability to rapidly handle (transload) those needs.

Personnel

The DAO serves as the focal point for all LID ammunition functions. The DAO section has only six people to accomplish the DAO mission, including representation at various nodes within the Class V resupply system.

A TO&E assignment requires an MOS of 55B (ammunition handler) in the forward supply company (TO&E 42027L000) of the S&T battalion. In garrison, the 55Bs perform non-MOS duties and do not train in their MOS.

The forward supply company of the LID has a strength level (Level 2) of 38 people to operate the BSA. The mechanized division has a forward support company of 55 people to accomplish the same functions.

LID personnel resources, by design, permit the establishment of only three ATPs. LID personnel concerned with ammunition resupply see the need for a fourth ATP to operate under the same concept that prevails in other types of divisions. An ATP section of only eight people does not permit drawing down on the three authorized ATPs to man a fourth ATP. The capabilities of an ATP section, again by design, limit operations to two 6-hour shifts versus 24-hour operations--a risk that was dictated by austere "tailoring" and fully recognized by the LOGCEN planners.

Overall Army personnel constraints have resulted in the assignment of only one driver per vehicle. This presents a situation that has been stated to be "marginal" at best in peacetime and will probably present an unmanageable dilemma in wartime operations.

The separate 155mm howitzer battery is assigned the mission of general support to the division and draws ammunition from the ASP because the LID does not have an ATP to support divisional units. The 155mm battery is required to augment the ASP with battery personnel to perform ammunition handling and limited accounting functions. This requirement results in a draw down of personnel who have other duties to perform in discharging the battery's primary mission. The addition of a fourth ATP to the LID would resolve this problem and serve to enhance the resupply of other divisional units that are required to draw ammunition from the ASP.

There are no dedicated ammunition handlers in the air defense artillery (ADA) battalion. The capability to fire 3,000 rounds per minute at a weight of one pound per round is an example of the resupply problems in the ADA battalion.

Communications and Accountability

A review of TO&E authorized equipment, observation of field exercises, and interviews with personnel responsible for the accountability and control of ammunition in the resupply system revealed serious deficiencies in the ability of the LID to meet doctrinal

requirements in the management of the ammunition resupply system. The Communications and Automation subsection in the Army Concept for CSS section briefly addresses the total CSS system deficiencies. The objective of this study is to address deficiencies that can be resolved through "short-term, low-cost, nondevelopmental productivity-enhancing improvements" (see Subtask Number 3). Therefore, this report does not address findings concerning the total system; however, the findings and recommended "fixes" were developed with total system compatibility as a consideration.

The current system of communications and control is unresponsive. Reports of exercises and interviews with participating personnel have indicated that system response time from the time of the user request to receiving the ammunition varies from 36 to 48 hours. System response to changes is about 18 hours.

Key personnel, activities, and nodes within the system at the division level and below do not possess the communications or data transmission capability to effectively control Class V operations. Three basic examples to illustrate the problems are

1. The DAO, to communicate with his representative at the ATP must talk by radio with the FASCO at the BSA, who in turn talks with the DAO representative by land line.

2. Ammunition convoy commanders and drivers have no method of communicating with their units or with their destination, be it the ATP or ASP. Convoys depart from their point of origin, enter a "black hole," and emerge from that black hole at their intended destination with no knowledge of any changes in the location of their unit or the ATP. In turn, the user, the ASP, or the ATP has no knowledge of the status of the convoy after it has entered the black hole. Innovative and imaginative commanders devise procedures to control such situations when time and resources permit. However, the necessary hardware can be obtained only by "borrowing" from another unit or activity. Some ammunition units have purchased commercial hand-held radios and CB radios to perform their missions more effectively and efficiently.

3. The DAO must interact with no fewer than 17 organizations in the exchange of information and data (see the Class V Information and Data Flow subsection in the Army Concept for CSS section). The DAO has no means to transmit real time or near real time data, much less do it rapidly and, as is sometimes required, in a secure mode.

The manual system for maintaining inventory and accountability is time-consuming, labor-intensive, and can be inaccurate. There is a justifiable demand for automated, static, and on-the-move inventory control subsystems. Subsystems that are compatible with the total CSS system are achievable through the application of chip technology and concepts or hardware such as the logistics applications of marking and reading symbols (LOGMARS).

### Doctrine and Concepts

The doctrine and concepts for the LID are addressed in earlier sections of this report. Notwithstanding the coordinated and detailed planning that ensued relative to the mission, organization, functions, and concepts in the genesis of the LID, there are apparent deficiencies and shortcomings in the Class V logistics system. Some of these deficiencies and shortcomings are well-recognized within the Army logistics community, and they are receiving attention. The findings that follow impact the short-term readiness of the LID and were developed through the described methodology in response to the objective of the study.

The concept and TO&E resources that support the establishment of the ATPs apparently render, in practice, a makeshift operation. Individual ATP operations are predicated upon a risk factor of only 12 hours of operations in a 24-hour period. Based on the experience gained from field exercises, LID personnel believe that a fourth ATP or an increase in resources for the three authorized ATPs is essential to mission accomplishment.

As a corollary to the ATP dilemma, LID personnel desire 100% ammunition throughput to the ATP. Because of meager resources (vehicles and drivers) and the anticipated distances from the battalion trains to the ASP, it will be difficult if not impossible for the user to go to the ASP to pick up ammunition.

The retention of ammunition on corps vehicles for 6 hours at the ATP presents problems (see the Storage subsection, paragraph a, in the Visit Results section).

LID plans for CSS in the objective area consider both the availability and nonavailability of a corps slice. In some plans, ammunition distribution in airhead-type operations stipulates the movement of all ammunition to a "mini ASP" outside the airhead. In effect, such LID planning is an attempt to accomplish a corps mission with limited LID resources. Further, it typifies a stated lack of confidence in the actual presence of corps support in the area of operations. Some plans are based totally on the assumption that the LID will have a full corps slice. LID planning, based on established doctrine and concepts, is one prevailing consideration. However, the reality of contingency plans is also a prevailing factor in the development of CSS plans.

### Miscellaneous

Some LID unit commanders, including one senior commander, indicated that suspected problem areas and possible unknowns in the LID CSS system might prove to be critical in combat. Further, it was their opinion that an effort focused on LID CSS could be undertaken by the LOGCEN to assist in identifying and resolving suspected problem areas and unknowns. This effort might include dedicated, full-scale exercises and/or computer simulations.

Ammunition expenditure rate data pose a significant problem regarding validity and source. This is an "old saw;" however, no single organization or document can provide comprehensive data about all weapons systems in the current Army inventory.

## Analysis

### Ammunition Requirements Versus Capabilities

This portion of the report addresses the user unit's capability to conduct resupply operations with organic transportation assets. The data to support the discussion are provided in the tables in Appendixes B, C, and D. Tables B-1 through B-3 in Appendix B show the raw data that were used in developing the ammunition requirements and the transportation requirements tables in Appendix C and Appendix D.

All weapons and equipment data except for the 155mm howitzer battery were extracted from TO&Es. The 155mm howitzer battery source was the modified table of

organization and equipment (MTOE) that was provided by the 7th LID DAO because the TO&E was not available in the TRADOC TO&E data base. (All specific references are listed in the Bibliography section.)

After the weapons for each unit were identified by type and number authorized, the next step was to calculate the total expenditures per 24 hours for each weapon.

It was not possible to obtain the expenditure rates for all weapons from a single source. The primary source of ammunition expenditure data was FM 101-10-1 (Department of the Army, 1987). Data voids in FM 101-10-1 were filled using TRADOC proponent school data, if available, or data from previous ASI studies.

Table B-1 provides the expenditure rates for heavy, moderate, and light levels of intensity of operations. FM 101-10-1 did not reflect all levels of intensity of operations for all weapons. The moderate and light expenditure rates, when necessary, were calculated to be 65% and 35% of the heavy expenditure rate. This was not an arbitrary calculation. The average factor for the moderate and light rates included in FM 101-10-1 represented about 65% and 35% of the heavy expenditure rate. The tables of expenditures in Appendixes C and D were calculated based on the worst case, that is, heavy defense and heavy offense.

### Weapons Systems Organic to Selected Combat and Combat Support Units

Table B-1 contains the detailed listing of the types and quantities of organic weapons and ammunition expenditure rates for each type of unit shown in Table 4. The selected units represent the significant (greater than 95%) ammunition requirements of the division. Ammunition requirements for all other types of units in the division are considered to be insignificant in this analysis.

Table 4

Units Selected for Analysis

| Type unit (No. in the LID) | TO&E number |
|---|---|
| Light infantry battalion (9 each) | 07015L000 |
| 105mm artillery battalion (3 each) | 06125L000 |
| Separate 155mm artillery battery (1 each) | 06127 (MTOE) |
| Air defense artillery battalion (1 each) | 44115L000 |

### Requirements

Tables C-1 through C-7 in Appendix C and Tables D-1 through D-7 in Appendix D show expenditures for the selected LID units, a typical committed brigade, and the division totals. The bottom line factor in comparing requirements against capabilities is total tonnage. Tables 5 and 6 provide the heavy defense and heavy offense recap for the division by unit type for required quantities of ammunition in S/T per day.

Table 5

Light Infantry Division Recap of Type of Ammunition and Quantity (Short Tons) Per Day by Type of Battalion (Heavy Defense)

| | TYPE BATTALION | | | | | |
|---|---|---|---|---|---|---|
| #IN DIV= | 9 | 3 | 1 | 1 | | |
| TYPE AMMO | LIGHT INF | 105 MM ARTY | 155 MM BTRY | ADA (GUN/STGR) | TOTAL | % OF TOTAL |
| 20 MM | 0.00 | 0.00 | 0.00 | 20.01 | 20.01 | 1.76% |
| 60 MM | 14.63 | 0.00 | 0.00 | 0.00 | 14.63 | 1.29% |
| 81 MM | 81.12 | 0.00 | 0.00 | 0.00 | 81.12 | 7.14% |
| 105 MM | 0.00 | 812.86 | 0.00 | 0.00 | 812.86 | 71.57% |
| 155 MM PROJ | 0.00 | 0.00 | 82.49 | 0.00 | 82.49 | 7.26% |
| 155 PROP CH | 0.00 | 0.00 | 32.47 | 0.00 | 32.47 | 2.86% |
| LAW | 1.91 | 0.00 | 0.00 | 0.00 | 1.91 | 0.17% |
| STINGER | 0.00 | 0.00 | 0.00 | 4.34 | 4.34 | 0.38% |
| DRAGON | 23.55 | 0.00 | 0.00 | 0.00 | 23.55 | 2.07% |
| TOW | 16.91 | 0.00 | 0.00 | 0.00 | 16.91 | 1.49% |
| 5.56 MM | 8.98 | 2.44 | 0.30 | 0.63 | 12.34 | 1.09% |
| 5.56 MM (SAW) | 4.45 | 0.00 | 0.00 | 0.25 | 4.70 | 0.41% |
| 7.62 MM | 3.35 | 2.11 | 0.29 | 0.25 | 6.00 | 0.53% |
| 50 CAL | 0.00 | 0.12 | 0.00 | 0.00 | 0.12 | 0.01% |
| 40 MM | 5.98 | 0.87 | 0.12 | 0.14 | 7.11 | 0.63% |
| 66 MM | 15.21 | 0.00 | 0.00 | 0.00 | 15.21 | 1.34% |
| TOTAL | 176.10 | 818.39 | 115.66 | 25.61 | 1135.76 | 100.00% |

Table 6

Light Infantry Division Recap of Type of Ammunition and Quantity (Short Tons) Per Day by Type of Battalion (Heavy Offense)

| | TYPE BATTALION | | | | | |
|---|---|---|---|---|---|---|
| #IN DIV= | 9 | 3 | 1 | 1 | | |
| TYPE AMMO | LIGHT INF | 105 MM ARTY | 155 MM BTRY | ADA (GUN/STGR) | TOTAL | % OF TOTAL |
| 20 MM | 0.00 | 0.00 | 0.00 | 14.96 | 14.96 | 1.65% |
| 60 MM | 11.70 | 0.00 | 0.00 | 0.00 | 11.70 | 1.29% |
| 81 MM | 60.50 | 0.00 | 0.00 | 0.00 | 60.50 | 6.67% |
| 105 MM | 0.00 | 663.17 | 0.00 | 0.00 | 663.17 | 73.07% |
| 155 MM PROJ | 0.00 | 0.00 | 60.97 | 0.00 | 60.97 | 6.72% |
| 155 PROP CH | 0.00 | 0.00 | 24.07 | 0.00 | 24.07 | 2.65% |
| LAW | 1.91 | 0.00 | 0.00 | 0.00 | 1.91 | 0.21% |
| STINGER | 0.00 | 0.00 | 0.00 | 5.24 | 5.24 | 0.58% |
| DRAGON | 17.67 | 0.00 | 0.00 | 0.00 | 17.67 | 1.95% |
| TOW | 13.52 | 0.00 | 0.00 | 0.00 | 13.52 | 1.49% |
| 5.56 MM | 6.98 | 1.77 | 0.22 | 0.48 | 9.46 | 1.04% |
| 5.56 MM (SAW) | 3.34 | 0.00 | 0.00 | 0.21 | 3.54 | 0.39% |
| 7.62 MM | 2.61 | 1.61 | 0.21 | 0.21 | 4.64 | 0.51% |
| 50 CAL | 0.00 | 0.12 | 0.00 | 0.00 | 0.12 | 0.01% |
| 40 MM | 4.68 | 0.69 | 0.09 | 0.12 | 5.58 | 0.61% |
| 66 MM | 10.58 | 0.00 | 0.00 | 0.00 | 10.58 | 1.17% |
| TOTAL | 133.49 | 667.37 | 85.55 | 21.20 | 907.62 | 100.00% |

### Transportation Organic to Selected Units

Table B-2 is a listing of vehicles considered to be available for the transport of ammunition for each type of unit. In two cases, the TO&Es do not reflect the data shown in Table B-2. The ADA battalion TO&E does not show any dedicated ammunition vehicles. This analysis would not have been complete under that condition. Therefore, for the purposes of this study three HMMWVs with trailers were assigned to each of the two firing batteries in the battalion. In the second case, the TO&E for the 105mm howitzer battery does not show the planned increase in allowance of HMMWVs from six to seven. Again, for the purposes of this study, the additional vehicle with trailer was assigned to each of the three firing batteries in the battalion (see paragraph c. of the Ground subsection in the Visit Results section).

### Typical Brigade

The typical light infantry brigade. for ammunition requirements purposes, is comprised of given multiples or fractions of the units listed in Table 4. This study considered the typical brigade to be one-third of the total number of type units in a LID shown in Table 4. Therefore, the typical brigade is comprised of three infantry battalions, one 105mm howitzer battalion, one-third of a 155mm howitzer battery and one-third of an air defense artillery battalion. For purposes of reference, the units are referred to as complete units (battalion, battery, etc.); however, in Tables 8 through 14 it must be kept in mind that the requirements assets shown for the 155mm artillery and the ADA represent one-third of a battery and battalion, respectively.

### Ammunition Resupply Vehicle Basic Loads

For the purposes of this study, the ammunition basic load for a unit is defined as "The mix and quantity of ammunition that can be carried on the unit's dedicated ammunition resupply vehicles. The mix and quantity of ammunition contained in the basic load will be in direct proportion to the predetermined mix and quantities of ammunition expenditures for that unit." Therefore, the basic ammunition load was computed for the selected units based on dedicated ammunition vehicles organic to each unit. Table 7 lists the dedicated ammunition vehicles by the type of unit. Tables C-8 through C-11 in Appendix C and Tables D-8 through D-11 in Appendix D reflect the unit basic load capabilities and the computation of daily resupply requirements based on expenditures and available transportation. A more detailed discussion of daily ammunition requirements versus capabilities is provided in the Twenty-Four Hour Unit Resupply subsection in this section.

### Distribution of Forces

Figure 12 is a schematic of the currently postulated ammunition distribution system--the maneuver-oriented ammunition distribution system (MOADS). The concept assumes a mature theater (corps support and conventional ammunition distribution procedures have been established). The significant difference between the concept as it applies to other divisions versus the LID is the existence of a fourth ATP for other types of divisions. The fourth ATP has been deleted from Figure 12. LID planning factors incorporate varying distances from the battalion trains to the ATP and the ASP. For the LIDs visited, the average quoted distances used in planning are

Battalion trains to ATP: 40 kilometers
BSA (ATP) to ASP: 50 kilometers

Table 7

LID Dedicated Ammunition Vehicles

| Unit | 5/4-Ton Truck | 3/4-Ton Trailer | 5-Ton Truck | 1-1/2-Ton Trailer | Total Capacity (Short Tons) |
|---|---|---|---|---|---|
| Division | 54 | 54 | 18 | 18 | 225.00 |
| Light Inf Bn/9 Each | 6 | 6 | 0 | 0 | 12.00 |
| H&H Co/1 Each | 6 | 6 | 0 | 0 | 12.00 |
| Div Arty/1 Each | 18[a] | 18[a] | 18 | 18 | 117.00 |
| 105mm FA Bn/3 Each | 3 | 3 | 6 | 6 | 45.00 |
| 105mm Btry/3 Each | 1 | 1 | 2 | 2 | 15.00 |
| 105mm Btry | | | | | 39.00 |
| ADA (Gun/Stgr) Bn/ 1 Each | 6[b] | 6[b] | 0 | 0 | 12.00 |

[a]Data based on an increased allocation of two additional HMMWVs per 105mm artillery battery.

[b]TO&E shows no dedicated ammunition vehicles. For the purposes of this study, three HMMWVs with trailers were assigned to each of two gun/stinger batteries.

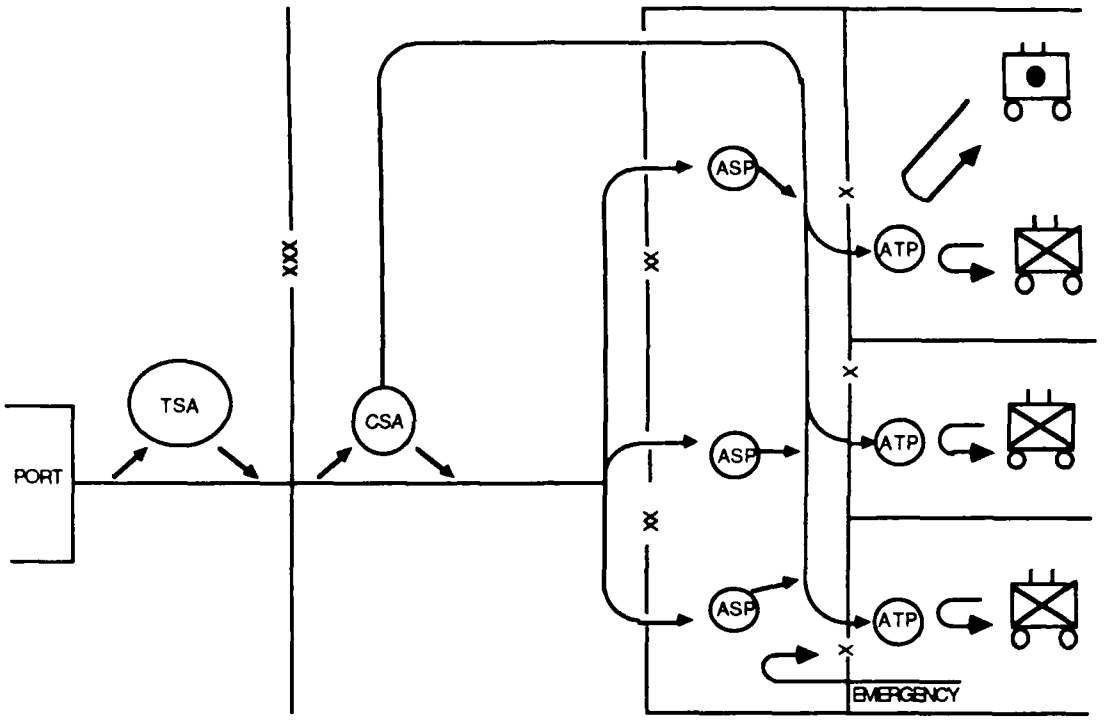



Figure 12. Maneuver-oriented ammunition distribution system (MOADS).

The committed infantry units (below battalion) do not possess an organic transportation resupply capability. The battalion ammunition section must travel the distance between the committed companies and the ATP. The distance of 40 kilometers just specified takes that into consideration regardless of the actual location of the battalion trains relative to the ATP. Therefore, a user (infantry battalion) could be expected to travel about 90 kilometers (56 miles) to pick up ammunition at the ASP and 40 kilometers (25 miles) to pick up ammunition at the ATP (see the Twenty-Four Hour Unit Resupply subsection in this section for an analysis of capabilities).

Current LID doctrinal publications do not provide conceptual distances between users and ammunition resupply nodes. Distances from supporting units (ADA and artillery) are calculated based on tactical employment considerations. The ADA elements are considered to be deployed throughout the division area, and therefore, an equivalent brigade's slice (of the division's assets that is deployed in a brigade's area) could be positioned at vantage points almost anywhere in the brigade's area of operations. Resupply distances are considered to be the same as for the infantry. The standard tactical employment of direct support artillery calls for positioning to take advantage of two-thirds of the range capability beyond the supported units. With a maximum range capability of 11.5 kilometers (non-RAP ammunition) for the 105mm howitzer (Technical Manual 43-0001-28), normal positioning would be one-third of the maximum range (4 kilometers) behind the infantry. The section of general support artillery (155mm) is positioned to perform counter battery fires and is considered to be in the general vicinity of the direct support artillery.

It should be noted that the current draft of FM 9-6 (Ammunition Service in the Theater of Operations) changes the concept that requires tactical units to draw most of their high-usage, high-tonnage resupply ammunition from the ATP and to pick up all other ammunition at the ASP. Under the new concept of MOADS and PLS, tactical units will draw all their ammunition from the ATP. Thus, the concept calls for 100% of required ammunition to be delivered on corps transportation to the ATP. A contributing author at the U.S. Army Ordnance, Missile and Munitions Center and School (OMMCS) confirmed that this procedure will apply to the LID. Most or all of the LID concerns regarding user transportation to and from the ASP in a mature theater will be eliminated. Conversely, current LID concerns regarding the capabilities of the ATP will be magnified.

Twenty-Four Hour Unit Resupply

The computations in this section are based on user capabilities to resupply all ammunition from an ATP in a mature theater. That is, all ammunition will be delivered on corps transportation to an ATP that is capable of transloading the required quantities of ammunition. Any deficiencies in ATP capabilities that were noted during the visits to the respective LIDs (see the ATP Operations subsection in the Visit Results section) must be noted; however, they are not considered critical in this analysis because the purpose of this analysis was to conduct an assessment of the user's capability to conduct resupply operations with organic transportation assets.

The basic rule for ammunition resupply is when one-third of the ammunition loaded on the unit's ammunition vehicles has been issued to the weapons and/or personnel, those empty vehicles will return to the ATP for replenishment of the ammunition issued. By knowing the rate at which the ammunition is issued (based on expenditure rate) it is possible to calculate the number of times that unit ammunition resupply vehicles must return for resupply during a 24-hour period. Based on the distance from the battalion trains to the ATP, it is possible to calculate the vehicle turnaround time (time for a vehicle to leave the battalion area and return with a full load of ammunition) necessary to keep the fighting forces completely supplied.

The worst case situation is presented when expenditures are used for a defensive posture in a heavy level of intensity of operations.

The LID planning factor for ATP transloading is 250 S/T per day.

The number of convoys that will return to the ATP each day is a function of the units' daily expenditures and its ammunition transportation capacity.

Table 8 shows the total expected expenditures for each type of unit in the brigade. For the conditions used in this analysis, the brigade total for S/T of ammunition per day exceeds the planning factor of the ATP of 250 S/T per day.

Table 8

Expenditures by Type of Unit (Heavy Defense)

| Unit | Number in brigade | 24-hour expenditures (S/T per unit) | Brigade total |
|---|---|---|---|
| Infantry battalion | 3 | 19.57 | 58.71 |
| Artillery battalion (105mm) | 1 | 272.80 | 272.80 |
| Artillery battery (155mm) | 0.33 | 115.66 | 38.55 |
| ADA battalion | 0.33 | 25.36 | 8.45 |
| Brigade total | | | 378.51 |

Table 9 shows the transportation assets that are available for ammunition support for each unit.

Table 9

Type and Number of Vehicles Available for Ammunition Resupply by Type of Unit Assigned to the Brigade

| Vehicle | Infantry battalion | Artillery battalion (105mm) | Artillery battery (155mm)[a] | ADA battalion[a] |
|---|---|---|---|---|
| 5-ton | 0 | 6 | 2 | 0 |
| 1.5-ton trailer | 0 | 6 | 2 | 0 |
| 5/4-ton truck | 6 | 3 | 0 | 2 |
| 3/4-ton trailer | 6 | 3 | 0 | 2 |
| S/T capacity | 12 | 45 | 13 | 4 |

[a]Number of vehicles is a factor of 0.33 of unit total that is shown in Table 7.

As stated earlier, the basic rule of thumb for ammunition resupply is when one-third of the ammunition available on the resupply trucks has been expended (off-loaded from the resupply vehicles), the empty trucks will return to the ATP for resupply. Thus, when one-third of the ammunition-carrying truck capacity is empty, the unit will send a resupply convoy to the ATP.

Table 10 combines the expenditure (and thus resupply) requirements for each unit specified in Table 8 with the transportation capabilities listed in Table 9 for each unit in the brigade. It is important to understand that, given the realities of combat, ammunition vehicles are the prime targets for interdiction missions. Attrition is not considered in the determination of convoy requirements in this study.

In Column 6 of Table 10, under Resupply Convoys Per Day Per Unit, none of the type of units in the typical brigade requires an even number (whole number) of convoys per day. Rather, each requires a fraction. Thus, some common sense must be used in rounding up or down to determine the actual number of convoys per day. For this study, if the fraction is less than or equal to 0.25, the number is rounded down. If the fraction is greater than 0.25, the number of convoys is rounded up to the next whole number. In Column 6 the whole number of convoys are in parentheses. The total number of convoys to be resupplied at the ATP for the brigade in a 24-hour period is 79 (45+18+9+7). This is, admittedly under worst case conditions, an inordinate number of convoys to be serviced by the ATP. However, by using the 0.35 factor for a light level of intensity of operations, discussed in the Analysis section, a "rough cut" of the number of convoys reveals a requirement of 28 (79 x 0.35) per 24-hour period at the ATP. This would require the ATP to effectively and efficiently service an average of more than one convoy per hour. Operating under the postulated LID CSS concept of two 6-hour shifts per day, the ATP, on the surface, cannot support the brigade.

Further, it can be seen in Column 6, Table 10, that the required number of vehicles per convoy exceeds the vehicle availability for all units. That is, using the one-third rule of thumb to initiate resupply, one-third of the daily expenditure rate exceeds one-third of available assets at any given time in all cases.

The unit's ability to meet daily resupply requirements essentially depends on S/T rather than types of ammunition except in the case of the infantry battalion. The infantry battalion has the need to transport "packages" such as the TOW that "cube out" before they "weight out" and that are difficult to load aboard the HMMWV because of their size. This situation will increase the problems of the infantry battalion in effecting resupply.

Table 11 provides the unit convoy travel time and upload times for the typical brigade. Distances to the front line user battalion trains are based on scenario planning factors used by the LIDs and field exercise experience of the LIDs (see the Distribution of Forces subsection in the Analysis section). Speeds are based on FM 101-10-1's planning factors. Upload times have been derived from the results of the U.S. Army Human Engineering Laboratory Forward Ammunition Supply and Transfer (HELFAST) tests specifically conducted for that purpose. Upload times during the day or night in the ATP for 5-ton trucks without on-board MHE are 10 minutes; vehicles (truck or trailer) with less than 2.5 tons are 5 minutes. A truck and trailer are treated as two vehicles. Convoy loiter time in the ATP is 5 minutes during the day and 10 minutes at night. Therefore, a convoy comprised of one 5-ton truck with a trailer and one 5/4-ton truck with a trailer will require 35 minutes (0.6 hour) to load at night. Since the time factors were developed under test conditions, they are considered to be optimistic times.

It is estimated that 55% of the convoys will travel during daylight, 35% will travel at night, and 10% will be day/night convoys per 24-hour period. That is, if six trips

Table 10

Daily Resupply Convoys Per Day by Type of Unit (Heavy Defense)

| 1 | 2 | 3 | 4 | 5 | 6 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Resupply Convoys Per Day[a] | | |
| Type Unit | No. in Bde. | Lift Capacity Per Unit (S/T) | One-Third Lift (S/T) | Unit Daily Requirement (S/T) | Per Unit | Bde. Total | Vehicle/Convoy |
| Inf. Bn. | 3 | 12.00 | 4.00 | 19.57 | 4.89 (5) | (15) | 2 HMMWVS with trailers |
| Arty. Bn. (105mm) | 1 | 45.00 | 15.00 | 272.80 | 18.19 (18) | (18) | 2 5-ton trucks with trailers & 1 HMMWV with trailer |
| Arty. Btry. (155mm) | 0.33[b] | 13.00 | 4.33 | 38.55 | 8.90 (9) | (9) | 1 5-ton truck |
| ADA Bn. | 0.33[c] | 4.00 | 1.33 | 8.45 | 6.35 (7) | (7) | 1 HMMWV with trailer |

[a]Number in parentheses represents convoys rounded to nearest even (whole) number. Rounding: 0.25 or less rounded down; greater than 0.25 rounded up.

[b]One-third of a 155mm battery.

[c]One-third of an ADA battalion.

Table 11

Travel and Upload Times (Heavy Defense)

| Unit | Round Trip Distance[a] From Combat Trains to ATP (Kms) | Travel Time[b] (hours) | | | Number of Vehicles[c] in Convoy | | | | Convoy Time at ATP (hours) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Day | Night | Day/Night | 5T | 1.5T | 5/4T | 3/4T | Day | Night | Day/Night |
| Inf. Bn. | 80 | 3.2 | 6.2 | 4.2 | 0 | 0 | 2 | 2 | 0.4 | 0.5 | 0.5 |
| Arty. Bn. (105mm) | 72 | 2.9 | 5.5 | 3.8 | 2 | 2 | 1 | 0 | 0.7 | 0.8 | 0.8 |
| Arty. Btry. (155mm) | 72 | 2.9 | 5.5 | 3.8 | 1 | 0 | 0 | 0 | 0.3 | 0.3 | 0.3 |
| ADA Bn. | 80 | 3.2 | 6.2 | 4.2 | 0 | 0 | 1 | 1 | 0.3 | 0.3 | 0.3 |

[a]See the Distribution of Forces subsection in the Analysis section.
[b]Convoy speeds: Day - 25 kilometers per hour (KMPH); Night - 13 MKPH; Day/Night - 19 KMPH (FM 101-10-1 Planning Data).
[c]One truck with trailer is treated as two vehicles for time at the ATP.

are required in a 24-hour period, three will be accomplished during the day, two at night, and one during day/night conditions. Upload times for day/night trips are considered as night upload times.

Table 12 shows a breakdown of day, night, and day/night convoys that are required for each unit in the brigade. The minimum between-convoy departure times are also listed for each 24-hour period. As was shown in Table 11, the number of vehicles per convoy must be drastically increased to reduce the number of daily convoys to meet resupply requirements; this is not a feasible option. However, it is impractical to expect any of the units to accomplish the daily convoy requirements shown in Table 12. As an example, from Table 12 relative to Minimum Departure Time Between Convoys, the artillery battalion must dispatch one-third of its ammunition vehicles every 1.3 hours in a 24-hour period. A round-trip time of 2.9 hours plus an ATP time of 0.7 hours (see Table 11) during daylight requires that a third convoy depart the battalion area approximately 1 hour before the first convoy has returned to the battalion area. Using one-third of its vehicles per convoy, all ammunition vehicles would be out of the battalion area for a 1-hour period during the first three trips. The situation is compounded as the day progresses--the battalion is either without ammunition or has ammunition on the ground and cannot move with unused ammunition. The situation described assumes an even distribution of expenditures and resupply throughout a given 24-hour period. However, the realities of combat do not produce even distributions. Expenditures follow a very uneven distribution over any given time period. Surges in expenditures and displacement of the firing batteries and the ATP serve to compound the user's resupply dilemma in the LID.

Table 13 shows the reduction in requirements for moderate defense and light defense levels of intensity of operations for the type of units of a typical brigade. The "rough cut" data in Table 13 were obtained by applying the 65% and 35% factors to the heavy defense requirements discussed in the Ammunition Requirements Versus Capabilities subsection of the Analysis section.

The moderate and light levels of expenditures reduce convoy requirements to an apparently "tolerable" situation for the infantry, 155mm artillery, and the ADA element. The direct support artillery (105mm) is still faced with a significant transportation requirement when one considers the number of trips required to fulfill daily resupply requirements for "light" levels of expenditures.

Based on the data in Table 13, a comparison of the Minimum Time Between Convoy Departures for the three levels of intensity of operations is presented in Table 14. Overall, the times are reasonable. Minimum departure time between the convoys for the direct support artillery battalion under the "light" level of expenditures is increased to 3.4 hours. As in the example cited earlier for this same unit, a convoy and ATP upload time of 3.6 hours will now result in the first convoy's estimated time of arrival back to the battalion at about the same time that the second convoy is to depart. The battalion will now have only one-third of its ammunition transportation assets on the road at any given time. This, too, is a reasonable situation. The LID was structured for low-intensity conflict. This is not to say that all low-intensity conflicts will be characterized by light levels of intensity of operations. Moderate and heavy levels of intensity of operations are to be anticipated and otherwise "reasonable situations" could easily escalate to "intolerable situations."

Table 12

24-Hour Convoy and Time Requirements (Heavy Defense)

| Unit | No. of Trips Required 24 Hours | Day[a] | | Night | | Day/Night | | Minimum Departure Time Between Convoys (hours) |
|---|---|---|---|---|---|---|---|---|
| | | Time/Trip[b] (hours) | No. of Trips | Time/Trip (hours) | No. of Trips | Time/Trip (hours) | No. of Trips | |
| Inf. Bn. | 5 | 3.2 | 3 | 6.2 | 2 | 4.2 | 0 | 4.8 |
| Arty. Bn. (105mm) | 18 | 2.9 | 10 | 5.5 | 6 | 3.8 | 2 | 1.3 |
| Arty. Btry.[c] (155mm) | 9 | 2.9 | 5 | 5.5 | 3 | 3.8 | 1 | 2.7 |
| ADA. Bn.[d] | 7 | 3.2 | 4 | 6.2 | 2 | 4.2 | 1 | 3.4 |

[a]Number of trips based on a 55% day, 35% night, and 10% day/night ratio.
[b]Round-trip time.
[c]Data represent one-third of a battery.
[d]Data represent one-third of a battalion.

Table 13

24-Hour Ammunition Expenditures and Convoy Requirements (Heavy, Moderate, and Light Defense)

| Unit | One-Third Lift Capacity | Heavy Defense | | | Moderate Defense | | | Light Defense | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Expend. | Trips | Veh./Convoy | Expend. | Trips | Veh./Convoy | Expend. | Trips | Veh./Convoy |
| Inf. Bn. | 4.00 | 19.57 | 5 | 2 HMMWVs & 2 trailers | 12.72 | 3 | 2 HMMWVs with trailers | 6.85 | 2 | 1 HMMWV with trailer |
| Arty. Bn. (105mm) | 15.00 | 272.80 | 18 | 2 5-ton trucks with trailers & 1 HMMWV with trailer | 177.32 | 12 | 2 5-ton trucks with trailers & 1 HMMWV with trailer | 95.48 | 7 | 2 5-ton trucks with trailers & 1 HMMWV |
| Arty. Btry.[a] (155mm) | 4.33 | 38.55 | 9 | 1 5-ton truck | 25.06 | 6 | 1 5-ton truck | 13.49 | 3 | 1 5-ton truck |
| ADA Bn.[b] | 1.33 | 8.45 | 7 | 1 HMMWV with trailer | 5.49 | 4 | 1 HMMWV with trailer | 2.96 | 2 | 1 HMMWV with trailer |

[a]Data represent one-third of a battery.
[b]Data represent one-third of a battalion.

Table 14

Minimum Departure Time Between Convoys (Heavy, Moderate, and Light Defense)

| Unit | Minimum departure times in hours | | |
|---|---|---|---|
| | Heavy | Moderate | Light |
| Infantry battalion | 4.8 | 8 | 12 |
| Artillery battalion (105mm) | 1.3 | 2 | 3.4 |
| Artillery battery[a] (155mm) | 2.7 | 4 | 8 |
| ADA battalion[b] | 3.4 | 6 | 12 |

[a]Data represent one-third of a battery.
[b]Data represent one-third of a battalion.

Analysis Summary

This first level examination of the user's ability to efficiently and effectively conduct Class V resupply operations is based on expenditures in a "heavy defense" posture. The approximation of expenditures of a unit, when committed to combat, could be significantly less or more. The rates (rounds per tube per day) for specific weapons could vary depending on the source of the information. The travel times, as factors of distance and terrain, would also vary among scenarios and between units within a given scenario. It is important to remember that what has been developed are approximations that would show different results if the baseline data were changed. An example of changes in results is shown in the convoy requirements (see Table 13) and in the departure times (see Table 14) when the expenditures are subjected to "rough cut" reductions for levels of intensity of operations--from heavy defense to moderate defense (65%) to light defense (35%).

## CONCLUSIONS

The paragraph organization of this section follows the subparagraph titles of the Visit Results section.

### Transportation

Most LID units have a significant shortfall in their capability to transport organic equipment and to haul ammunition basic loads.

Ground

Not all ammunition loads (packages) to be transported by the HMMWV fit between the wheel wells.

The HMMWV lacks cargo tie-down capabilities.

Artillery personnel prefer the 5-ton or 2-1/2-ton truck to the HMMWV as the prime mover for the 105mm howitzer because of total load requirements. The 105mm howitzer battery cannot move as a battery and conduct concurrent ammunition resupply operations. Artillery commanders in some units, because of inadequate transportation, intend to overload vehicles to the maximum capacity when moving. Based on the requirements of the 105mm howitzer battery, two additional HMMWVs were tentatively added to the battery's authorization of six (prime movers). The allocation of one additional HMMWV for the direct support artillery battery is not adequate for the needs of the battery in transporting the basic load and TO&E equipment.

In the absence of corps support, the intent is to clear ammunition from the airhead to a "mini ASP." Based on experience gained during exercises, the LID will not be able to effectively clear the airhead in a timely manner without drop-side 5-ton trucks and S&P trailers.

All 5-ton trucks dedicated to Class V resupply do not have dropsides.

Limited quantities of transportation and driver assets, coupled with the anticipated distances from the user to the ASP will severely limit, or even preclude the users' ability to conduct resupply operations between their positions and the ASP.

Operations with the M915 tractor trailer in forward areas, in open terrain, or on cross-country roads is impractical.

The movement of forklift trucks within CONUS is accomplished with commercial equipment transporters.

A smaller PLS system (e.g., 5-ton) would have application in the LID under the MOADS concept especially for artillery units with anticipated high tonnages of ammunition expenditures.

Air

Among the LIDs visited, the SOP for the planned use of helicopter assets differs (maneuver versus resupply versus evacuation, etc.).

LID units conduct day and night training in helicopter resupply operations.

Handling and Storage

Vehicle MHE

Five-ton trucks dedicated to Class V resupply do not have on-board MHE to self-load and unload heavy pallets of ammunition.

Other MHE

For ammunition handling, too much reliance is placed on "troop labor" by troops who have other duties.

An air-transportable 10-K forklift has been authorized for issue to the LIDs, replacing the IH 10 K and some of the 6 Ks on a one-for-one basis.

The loading and unloading of PLS pallets require an MHE capability. This is especially burdensome in units that have a high tonnage of ammunition expenditures (e.g., artillery units) and no MHE to handle the pallets.

The loading and unloading of user vehicles require the "breaking" of pallets and the subsequent loading and unloading of individual boxes or rounds.

There is a need for MHE that has the characteristics and capabilities of unit basic load-upload equipment.

The DISCOM lacks sufficient quantities of pallets and slings to conduct effective training and to efficiently accomplish resupply functions.

ATP Operations (see the Personnel, Communications and Accountability, and Doctrine and Concepts subsections below for ATP-related conclusions.)

Given the numbers of authorized forklifts and forklift operators, ATP personnel expect difficulty in transloading the required tonnage of 250 S/T of ammunition per day in a combat environment. This will impact heavily on the efficient and effective support required by the user.

Based on the extensive experience of ATP personnel, sectional ramps with rollers and powered conveyor belts have been used to great advantage with boxed ammunition in ATP and similar ammunition transloading operations.

Packaging

The following conclusions relate to the impact of packaging on ammunition handling:

The current method of ammunition packaging is a logistician's solution to wholesale distribution. This has been an often stated dilemma for all Army divisions; however, considering the Spartan nature of the LID, the situation presents a more difficult problem for the LID.

The packaging of 81mm mortar rounds in two-round units does not fall in line with the infantry commanders' practice of one round per soldier. One-round packages are preferred.

Storage

The current procedure of retaining ammunition on corps vehicles at the ATP for a 6-hour period is impractical. It "ties up" assets and could result in the user arriving "1 minute" after the ammunition has been dispatched back to the CSA.

Current inventory control and accountability procedures make it difficult to support the user in an accurate and timely fashion. The concepts postulated under the AirLand Battle will increase the complexity of this problem.

Personnel

The DAO section, with only six people, is understaffed.

In garrison, ammunition handlers (MOS 55B) perform non-MOS duties and rarely train in their MOS.

The forward supply company of the LID, with only 38 people to operate the BSA, is understaffed.

LID personnel resources permit the establishment of only three ATPs (design concept). An ATP section of only eight people does not permit drawing down on the three authorized ATPs to man a fourth ATP. An ATP is limited to two 6-hour shifts in a 24-hour period (again, design concept).

One driver is assigned to each vehicle. This is an overall Army policy that is dictated by personnel constraints.

The addition of a fourth ATP to the LID would enhance the Class V resupply and mission accomplishment of the separate 155mm howitzer battery and alleviate some of the burden of Class V resupply of other divisional units that are required to draw ammunition from the ASP.

There are no dedicated ammunition handlers in the ADA battalion.

Communications and Accountability

The current system of communications and control is unresponsive.

Key personnel, activities, and nodes within the system at the division level and below do not possess the communications or data transmission capability to effectively control Class V operations. Three basic examples to illustrate the problems are

1. The DAO cannot communicate directly with his representative at any of the ATPs.

2. Ammunition convoy commanders and drivers have no method of communicating with their units, the ATP, or the ASP. Innovative and imaginative commanders devise procedures for control; however, necessary hardware (e.g., radios) must be borrowed. Some ammunition units have purchased commercial hand-held radios and citizen band (CB) radios to perform their missions more effectively and efficiently.

3. The DAO must interact with no fewer than 17 organizations in the exchange of information and data. The DAO has no means to transmit or receive real time or near real time data.

The manual system for maintaining inventory and accountability of ammunition is time-consuming, labor-intensive, and can be inaccurate.

### Doctrine and Concepts

There are apparent deficiencies and shortcomings in the Class V logistics system. Some of these deficiencies and shortcomings are well recognized within the Army logistics community, and they are receiving attention. The conclusions that follow impact the short-term readiness of the LID and were developed through the described methodology in response to the objective of the study:

The concept and TO&E resources that support the establishment of the ATPs apparently render, in practice, a makeshift operation. LID personnel think that a fourth ATP or an increase in resources for the three authorized ATPs is essential to mission accomplishment.

As a corollary to the ATP dilemma, LID personnel desire 100% ammunition throughput to the ATP.

The retention of ammunition on corps vehicles for 6 hours at the ATP presents problems.

Plans for CSS in the objective area differ among LIDs relative to the availability of corps assets normally required to support a division.

### Miscellaneous

Based on the recommendations of several LID unit commanders, including one senior LID commander, actions could be taken under LOGCEN direction that would help identify and resolve suspected problem areas and "unknowns" in the LID CSS system. These actions could include field exercises and/or computer simulations.

No single organization or document can provide comprehensive ammunition expenditure data about all weapons in the Army's current inventory.

## RECOMMENDATIONS AND INVESTMENT STRATEGY

The recommendations in this section follow the paragraph structure of the Conclusions section.

The following are recommendations:

### Transportation

The LID units' overall transportation assets and tactical mobility should receive a detailed evaluation relative to individual unit capabilities to transport basic loads and

TO&E equipment. (Coordinate with TRADOC [LOGCEN and the Transportation School] for possible analysis and evaluation of unit transportation capabilities versus the requirements to determine the impact of deficiencies or shortfalls on the units' capabilities to accomplish assigned missions.)

Ground

The adequacy of the HMMWV to transport certain ammunition packages (e.g., the TOW and the AT4) should be evaluated to determine if a near term investment in larger vehicles is needed for infantry units for specific high usage ammunition that is packaged too largely for the HMMWV. (Coordinate with TRADOC [OMMCS and the Transportation School]. Obtain LID feedback on specific requirements and ongoing actions at the Defense Ammunition Center and School [DACS] to determine if currently planned vehicle modifications fulfill the requirements.)

A cargo tie-down capability such as lay-flat rings should be installed in the HMMWV (see the previous paragraph).

The batteries of the direct support artillery battalion should be allocated two additional HMMWVs with trailers to increase the capability to transport the basic load and TO&E equipment (allocation would total eight HMMWVs). (Obtain LID feedback on specific requirements and recommend changes to TRADOC [LOGCEN and the Transportation School].)

The ability of the LID to effectively clear the airhead needs to be evaluated to determine the increased effectiveness and efficiency to be derived from the near term investment in drop-side 5-ton trucks and S&P tractors and trailers for that purpose. (We recommend this as a possible RAND Corporation analytical effort.)

All 5-ton trucks dedicated to ammunition transportation need to have drop sides. (Coordinate with TRADOC [LOGCEN and the Transportation School] to determine the feasibility of reallocating vehicles within the LID with the objective of assigning drop-side 5-ton trucks to ammunition functions. Secondary actions could include a program improvement program (PIP) to 5-ton ammunition vehicles that do not have drop sides, and/or modifications of LID unit TO&Es to assign the necessary quantities of drop-side 5-ton trucks to appropriate units.)

Because of the users' limited assets and inability to conduct resupply operations between their positions and the ASP, all ammunition should be distributed through the ATP. (Coordinate with OMMCS and the TRADOC munitions systems manager (MSM) to determine the current doctrine and make appropriate recommendations.)

The feasibility and application of a smaller PLS system (e.g., 5-ton) for the LID should be investigated. (Coordinate with TRADOC [LOGCEN and the Transportation School].)

Air

Limited field exercises and simulations, with well-defined objectives, should be conducted to determine the most effective and efficient use of helicopters by the LID in conducting maneuver, resupply, and medical evacuation operations. The inefficiency of using helicopters for ammunition resupply is documented in lessons learned

from the Vietnam conflict. Additionally, exercises dedicated to this purpose, under scenario conditions similar to what the LID might experience, have been conducted extensively in the past. The results of those exercises should be researched with the purpose of taking advantage of "lessons learned." A sample exercise was successfully conducted under the Marine Corps' sea-based mobile logistics system (SMLS) concept during which a MEB of 15,000 personnel totally relied on the helicopter for maneuver, evacuation, and resupply for extended periods of time. (We recommend this as a potential RAND Corporation analytical effort.)

All LID maneuver units need to conduct frequent day and night training in helicopter resupply operations. (This does not warrant a specific action other than LID and TRADOC information.)

### Handling and Storage

#### Vehicle MHE

An evaluation should be conducted to determine the feasibility of installing hydraulic tailgates and/or on-board cranes on selected numbers of 5-ton trucks dedicated to ammunition resupply operations. (Coordinate with TRADOC [LOGCEN and the Transportation School].)

#### Other MHE

The fielding of the new air-transportable 10-K forklift needs to be expedited (truck, forklift, rough terrain [Air Force model 10 K], TO&E line number 49119.)

Artillery units should be equipped with multifunction vehicles (e.g., the wheeled tractor with forklift and crane attachments) with MHE capabilities and/or UBL-upload equipment to enhance their capability to conduct resupply operations and to reduce the reliance on troops who have other functions in accomplishing the unit mission. (Obtain LID feedback about specific requirements and coordinate actions with TRADOC [LOGCEN].)

The availability of pallets and slings in the DISCOM needs to be evaluated to determine the adequacy of authorized quantities to conduct effective training and to efficiently accomplish resupply functions. (Obtain LID feedback about specific requirements and coordinate with TRADOC [LOGCEN].)

#### ATP Operations (see the Personnel, Communications and Accountability, and Doctrine and Concepts sections below for other ATP-related recommendations.)

Field exercises and simulations should be conducted, with well-defined objectives, to "stress" the ATP in its ability to accomplish its transload mission. (Evaluate to determine the feasibility of conducting realistic ammunition resupply training at the National Training Center. Coordinate with TRADOC [OMMCS].)

Field exercises and simulations should be conducted for the purpose just stated and should include varying quantities of forklifts and forklift operators at the ATP. Equipment such as sectional ramps with rollers and powered conveyor belts should be included.

Resources to establish a fourth ATP to support divisional units should be added to the LID TO&E. (Coordinate with TRADOC [LOGCEN].)

### Packaging

The following recommendations relate to the impact of packaging on ammunition handling:

- An immediate investment should be made to increase the magnitude of the current effort in developing "user-friendly packages" for selected, high demand types of ammunition in an accelerated program.

- An effort needs to be initiated to develop one-round packages of 81mm mortar ammunition.

### Personnel

The conclusions related to the inadequacy of personnel (DAO section, forward supply company, ATP section, drivers, artillery unit troop assistance to the ASP, and the ADA battalion) are attributable to overall Army personnel constraints or the strategic mobility tailoring of the LID. Therefore, based on specific scenario requirements and before deployment, appropriate units in the LID should be augmented with personnel through modified TO&Es when it is necessary to meet mission requirements. (Coordinate with TRADOC and Forces Command [FORSCOM].)

The ammunition handlers should be assigned where they will have the opportunity to receive adequate training enabling them to accomplish their duties in combat (Internal LID action).

### Communications and Accountability

The specific needs to immediately improve the communications and accountability posture of the LID's Class V resupply system should be determined through dedicated field evaluations of the current communications and automation system. This would be compared to similar evaluations in which immediately available NDI (nondevelopmental item) hardware is used and will enhance the responsiveness, accountability, and accuracy of the Class V resupply system. Without further evaluations, immediate enhancement can be achieved by

- a. identifying specific vendors that have hardware and software in production that are fieldable and compatible with current and proposed Army communications and automation concepts. Relatively inexpensive systems exist that provide secure, high-speed data with voice and graphics transmission capabilities.

- b. obtaining and equipping (for evaluation purposes) key personnel, activities, and nodes within the system at the division level and below with the off-the-shelf hardware and software discussed in the above paragraph.

If a more immediate and less expensive approach toward achieving system enhancement is desired, it can be experienced through selective improvements such as

a. providing the DAO with the capability to communicate by radio with his representatives at the various nodes in the system. (Coordinate with TRADOC.)

b. providing the DAO with the means to transmit and receive data in real time or near real time. (Coordinate with TRADOC [Munition Systems Manager and OMMCS].)

c. providing convoy commanders and vehicle drivers with inexpensive radios such as those purchased by some ammunition units to enhance convoy control (e.g., hand-held units and CB radios). (Obtain LID feedback about specific requirements and coordinate with TRADOC.)

d. immediately implementing a system (e.g., improved LOGMARS) to eliminate the time-consuming, personnel-intensive, and often inaccurate manual system for conducting static storage inventory in the ASP and CSA. (Coordinate with TRADOC [LOGCEN and OMMCS].)

e. accelerating the development and implementation of a system to enhance "inventory in motion" that is readily achieveable through chip technology. (Coordinate with TRADOC [LOGCEN and OMMCS].)

### Doctrine and Concepts

Recommendations derived from the specific conclusions in the Doctrine and Concepts subsection of the Conclusions section that are relative to the ATP were also addressed in the ATP Operations, Personnel, and Communications and Accountability subsections of the Conclusions section. Those recommendations are not repeated in this section. However, it is significant to reiterate that the ATP has surfaced as a major shortcoming in the LID's Class V logistics system. Therefore, recommendations made earlier should be strongly kept in mind in any evaluation of the doctrine or concept that impacts the ATP functions in the LID.

Plans for CSS for the LID in the objective area should consider the impact of the nonavailability of corps support units. (We recommend this as a possible RAND Corporation analytical effort.)

### Miscellaneous

Action should be taken to determine the potential for conducting field exercises and/or computer simulations, under the direction of the LOGCEN, to help identify and resolve suspected problem areas and "unknowns" in the LID CSS system. (We recommend this as a possible RAND Corporation analytical effort.)

It is important that the action initiated to develop comprehensive ammunition expenditure data for all weapons in the Army's current inventory be re-emphasized and that the effort be accelerated. (Coordinate with the Combined Arms Center and the TRADOC Research and Analysis Center.)

## FINAL NOTE

The analysis and recommendations provided in this report are primarily based on specific baseline data and the results of visits to specific U.S. Army units. Other input, as specified in the methodology, influenced the results. It is necessary that three specific aspects of the study be noted.

First, the analysis of the user's ability to efficiently and effectively conduct Class V resupply operations was a first level examination based on a given set of baseline data. Other approximations of unit requirements and capabilities could produce different results. Expenditure rates, distances, and terrain will vary depending on the source of the information and the defined scenario. Examples of the significant differences that could be achieved were demonstrated in the analysis.

Second, recommendations provided in this report include the compilation of information derived from discussions with LID personnel involved in transporting, handling, storing, and controlling ammunition. It is recognized that some of the information obtained from interviews could be based on limited personal experience and/or opinion. Regardless of the determination of the authors to account for such factors in personal interviews, it is not always possible to eliminate them completely.

Finally, some of the recommendations that have been made may be viewed as "pie in the sky" beyond the scope of the study or as being impractical or infeasible. Nonetheless, the authors feel compelled to present all information obtained during the study.

# BIBLIOGRAPHY


## Field Manuals

| | |
|---|---|
| FM 29-50 | Direct Support Supply and Field Services |
| FM 9-6 | Ammunition Service in the Theater of Operations |
| FM 9-38 | Conventional Ammunition Unit Operations |
| FM 7-4 | USMC Doctrinal Publications Guide |
| FM 7-72 | Light Infantry Battalion |
| FM 7-71 | Light Infantry Company |
| FM 7-70 | Light Infantry Platoon/Squad |
| FM 101-10-1 | Staff Officer's Field Manual: Organizational, Technical, and Logistic Data |

## Technical Manuals

| | |
|---|---|
| TM 43-0001-28 | Artillery Ammunition Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers, and Artillery Fuzes (Federal Supply Class 1310, 1315, 1320, 1390) |

## Field Circulars

| | |
|---|---|
| FC 7-13 | Light Infantry Battalion and Brigade Operations and Battalion ARTEP Mission Training Plan (AMTP) |
| FC 7-15 | Light Infantry Squad and Platoon Operations and ARTEP Mission Training Plan (AMTP) |
| FC 7-14 | Light Infantry Company Operations and ARTEP Mission Training Plan (AMTP) |
| FC 63-2-1 | Combat Service Support Operations--Light Infantry Division |
| FC 63-31 | Corps Combat Service Support to the Light Infantry Division |
| FC 71-101 | Light Infantry Division Operations |
| FC 100-1 | The Army of Excellence |

## Pamphlets

| | |
|---|---|
| (not assigned) | Ammunition Interoperability Pamphlet for United States/Germany |

| | |
|---|---|
| TRADOC 525-49 | U. S. Army Operational Concept For Ammunition Support on the AirLand Battlefield |
| TRADOC 525-36 | U. S. Army Operational Concept for Host Nation Support |
| TRADOC 525-9 | U. S. Army Operational Concept for Ammunition Support on the AirLand Battlefield |

TO&Es

| | |
|---|---|
| 44115L0 | Air Defense Artillery Battalion, SHORAD, Light Infantry Division |
| 06100L0 | Light Infantry Division Artillery |
| 06120L0 | Headquarters and Headquarters Battery, Light Infantry Division Artillery |
| 06125L0 | Field Artillery Battalion, 105mm Towed, Light Infantry Division |
| 63021L0 | Division Support Command, Infantry Division (Light) |
| 63022L0 | Headquarters and Headquarters Company Support Command, Infantry Division (Light) |
| 08045L0 | Medical Battalion Support Command, Light Infantry Division |
| 42025L0 | Supply and Transport Battalion Division Support Command, Infantry Division (Light) |
| 43045L0 | Ordnance (Maintenance) Battalion Support Command, Light Infantry Division |
| 01977L0 | Aviation Company (AVIM) Support Command, Light Infantry Division |
| 77000L0 | Light Infantry Division |
| 77004L0 | Headquarters and Headquarters Company Light Infantry Division |
| 77042L0 | Headquarters and Headquarters Company Light Infantry Division Brigade |
| 07015L0 | Infantry Battalion, (Light), Light Infantry Division |
| 07016L0 | Headquarters and Headquarters Company Infantry Battalion, Light Infantry Division |
| 06127 | Separate 155mm Howitzer Battery (MTOE) |

FORSCOM Regulation

| | |
|---|---|
| 700-3 | Logistics: Ammunition Basic Load, HQ U.S. Army FORSCOM, 15 April 1986. |

Procedures

"Division Class V Basic Load Procedures," 10th Mountain Division, DAO, Ft. Drum, NY, 24 December 1986.

"Class V Tactical Deployment and Resupply Procedures (updated)," 10th Mountain Division (L.I.), Ft. Drum, NY.

"Ammunition Basic Load," 7th LID.

"Division Ammunition Operations (DAO/ATP Functions and Procedures)," ST 9-38-1, USAOMMCS, (undated).

Reports

"Division Ammunition Office Management Information System (DAOMIS)," Draft Report (A-201), DA Development & Employment Agency, Fort Lewis, Washington, 98433-5000, 29 October 1987.

"Unit Level Ammunition Management System (ULAMS)," Draft Report (A-202), DA Development & Employment Agency, Fort Lewis, Washington, 97433-5000, 29 October 1987.

"Truck Mounted Crane (TMC) Appraisal Report," ADEA Control No. A164, US ADEA, Ft. Lewis, Washington, 98433-5000, 19 November 1987.

"Vehicle Mounted Material Handling Equipment (VMMHE) Appraisal Report," ADEA Control No. A161, US ADEA, Ft. Lewis, Washington, 98433-5000, 16 October 1987.

"TCATA TEST REPORT FT490, Palletized Loading System (PLS) Ammunition Distribution System,"RCS ATTE-3, HQ TRADOC, Ft. Hood, Texas, 76544-5065, March, 1987.

"High Technology Light Division (HTLD) Class V Supportability Evaluation,"--After Action Report, USA MMCS, Redstone Arsenal, AL, 35897 (undated).

"Conventional Ammunition Review Report." USA UMMCS, Redstone Arsenal, AL, 11 April 1986.

"1986 DAO/BAO Conference After Action Report," USA OMMCS, Redstone Arsenal, AL, 1986.

"Minutes of the Worldwide Army Ammunition Review 29-30 October 1985," USA HQ U.S. Army Armament, Munitions and Chemical Command, Rock Island, IL, 61299-6000, 12 December 1985.

DAO/BAO Conference, After Action Report.

Class V Supportability Evaluation High Technology Light Division (HTLD) After Action Report.

Conventional Ammunition Review Report.

Articles

"The Light Infantry: Indispensable Element of a Balanced Force," by Gen. William E. DePuy, USA Retired, ARMY Magazine, June 1985.

"The U.S. Army Light Division - Right or Wrong?" by LTC David Eshel, IDF (Ret.), NATIONAL DEFENSE, May-June 1987.

"Ammunition Panel," pp.13-15, ORDNANCE, August 1987.

"Fast Reaction Forces U.S. Style," by Ramon Lopez, INTERNATIONAL DEFENSE REVIEW, Volume 20, No. 9/1987.

"The Army's Palletized Loading System is Facing a Rocky Road," MILITARY LOGISTICS FORUM, June 1987.

"Army Decides to Push for Light Tank, Reviving Canceled Armored Gun System," by Benjamin F. Schemmer, ARMED FORCES JOURNAL INTERNATIONAL, August 1987.

"The Division May Be 'Light' But Can It Fight?" by Col. Dale K. Brudvig, ARMY TIMES, September 10, 1984.

"The Krulak Paradigm," AMPHIBIOUS WARFARE REVIEW, Exposition Issue 1986.

"What's New At TRADOC?" by Nick Nichols, INTERNATIONAL DEFENSE REVIEW, August 1987.

"Rapid Deployment Forces to Get First of Lightweight Howitzers," by David Fulghum, ARMY TIMES, August 24, 1987.

"Light Divisions Get Extra Combat Punch," by Jim Tice, ARMY TIMES, March 18, 1985.

# APPENDIX A

## LIGHT INFANTRY DIVISION AMMUNITION LOGISTICS ENHANCEMENT VISIT OVERVIEW

## LIGHT INFANTRY DIVISION AMMUNITION LOGISTICS ENHANCEMENT VISIT OVERVIEW

A. Purpose of the Study

The objective of this effort is to assess and resolve ammunition handling, storage, and transportation deficiencies within the light infantry divisions by establishing a plan for product improvement, and materiel development activities for the improvement of ammunition logistics capabilities for the light infantry division (LID). The scope of the study will include the Class V resupply capabilities and limitations of the individual maneuver battalions, a "typical" brigade, and the support command of a light infantry division and the nondivisional direct support (DS) organizations that provide Class V support.

B. Method

Visits to the 29th, 10th, and 7th LIDs, the 9th I.D., I Corps Headquarters, and ADEA, as well as other internal and external ASI and HEL efforts.

C. General Purpose of Visits

1. Observe and record specific information about ammunition logistics (field exercise if available).

2. To obtain information regarding issues in paragraphs E and F below and to establish contact with key personnel within specific units for future detailed investigation of problem areas and potential solutions.

D. Key Personnel

As dictated by availability, maximum benefit will be derived from talking with as many of the below listed personnel as feasible.

Corps (as designated by the Corps Action Officer)
Division Commander or Deputy (desired, if schedule permits)
DISCOM Commander
DAO
S&T Battalion (S-3 and forward supply company commander)
Infantry, ADA, Artillery Battalion S-3/S-4
Brigade S-3/S-4
Unit Ammunition Logistics Personnel

E. Specific Areas of Interest

1. DISCOM Ammunition Transport and Management Capability (irrespective of mission)

a. Adequate
b. Inadequate
c. Specific problems (disadvantages)
d. Specific advantages

4. Nondivisional Class V DS Unit Transport Handling and Issue Capabilities in Support of the LID

5. Resupply System

   a. Shortcomings
   b. Choke points
   c. Nature of problem(s)

      (1) Personnel
      (2) Transportation
      (3) MHE

6. Fixes: Productivity Enhancements

   a. Short-term acquisition, low cost, NDI
   b. Other

7. TO&Es: Relative to Units with Ammunition Transport, Handling, and/or Issue Functions

   a. Actual
   b. Recent significant changes

F. Recent Field Exercises

1. Ammunition Logistics Oriented

   a. Difficulties experienced and attributable causes

   b. Equipment shortcomings

      (1) Transportation
      (2) MHE

   c. Doctrinal deficiencies

   d. Personnel deficiencies

      (1) Manning level
      (2) Availability
      (3) Training

   e. $C^3$

      (1) Adequacy
      (2) Equipment availability
      (3) Equipment performance

2. Other Field Experiences

3. Miscellaneous

e. $C^3$

(1) Adequacy
(2) Equipment availability
(3) Equipment performance

2. Other Field Experiences

3. Miscellaneous

# APPENDIX B

## LIGHT INFANTRY DIVISION RAW DATA

## Table B-1

## LID Weapons and Expenditure Data

| TYPE AMMO | WEAPON | QNTY | | | | R/T/D RATE (NT 1) | | | | | | 24 HR EXPEND (NT 2) | | | | | | RND PER PACK | PACK PER PALL | WEIGHT PER PALLET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | INF BN | 105 BN | 155 BTRY | ADA BN | DEFENSE | | | OFFENSE | | | DEFENSE | | | OFFENSE | | | | | |
| | | | | | | H | M | L | H | M | L | H | M | L | H | M | L | | | |
| 20 MM | ADA GUN | 0 | 0 | 0 | 18 | 2400 | 1560 | 840 | 1793 | 1166 | 628 | | | | | | | 100 | 24 | 2223 |
| 60 MM | MORT | 6 | 0 | 0 | 0 | 100 | 65 | 35 | 80 | 52 | 28 | | | | | | | 12 | 36 | 2340 |
| 81 MM | MORT | 4 | 0 | 0 | 0 | 88 | 58 | 31 | 66 | 43 | 24 | | | | | | | 3 | 30 | 1583 |
| 105 MM | HOW | 0 | 18 | 0 | 0 | 467 | 304 | 163 | 381 | 248 | 133 | | | | | | | 2 | 15 | 1934 |
| 155 MM PROJ | HOW (NT 3) | 0 | 0 | 8 | 0 | 207 | 135 | 72 | 153 | 99 | 54 | | | | | | | 1 | 8 | 797 |
| 155 PROP CH | HOW (NT 4) | 0 | 0 | 8 | 0 | 228 | 149 | 80 | 169 | 109 | 60 | | | | | | | 1 | 50 | 1780 |
| MISSILE | LAW (NT 5) | – | – | - | – | – | – | – | – | – | – | 42 | 28 | 15 | 34 | 23 | 12 | 15 | 3 | 425 |
| MISSILE | STGR (NT 6) | – | – | – | – | – | – | – | – | – | – | 82 | 54 | 29 | 99 | 65 | 35 | 1 | 9 | 952 |
| MISSILE | DRAGON | 18 | 0 | 0 | 0 | 4 | 2 | 1 | 3 | 2 | 1 | | | | | | | 1 | 20 | 1454 |
| MISSILE | TOW (NT 7) | 4 | 0 | 0 | 0 | 10 | 7 | 4 | 8 | 5 | 3 | | | | | | | 1 | 12 | 1127 |
| 5.56 MM | RIFLE | 502 | 400 | 135 | 313 | 90 | 59 | 32 | 67 | 44 | 24 | | | | | | | 1680 | 48 | 3547 |
| 5.56 MM | SAW | 58 | 0 | 0 | 0 | 320 | 208 | 112 | 256 | 167 | 90 | | | | | | | 1680 | 48 | 3955 |
| 7.62 MM | MG | 18 | 34 | 13 | 12 | 393 | 256 | 138 | 295 | 192 | 104 | | | | | | | 800 | 40 | 3312 |
| 50 CAL | MG | 0 | 1 | 0 | 0 | 159 | 104 | 56 | 120 | 78 | 42 | | | | | | | 200 | 48 | 3691 |
| 40 MM | HFL GREN | 58 | 26 | 9 | 12 | 19 | 13 | 7 | 15 | 10 | 6 | | | | | | | 50 | 21 | 1214 |
| 66 MM | MRL M202 | 9 | 0 | 0 | 0 | 10 | 7 | 4 | 7 | 5 | 3 | | | | | | | 4 | 2 | 294 |

NOTE 1: Level of intensity: H, heavy; M, moderate; L, light. Source of R/T/D RATE data is FM 101-10-1 unless otherwise indicated. If M and L data were not available in source documents, M=0.65xH and L=0.35xH were used; these factors are representative of the data for other weapons systems in the data source documents.

NOTE 2. 24 HOUR EXPEND are calculated values except for LAW & STINGER.

NOTE 3: 155MM PROJ is HE,M107.

NOTE 4: Propellant is WB, M4. R/T/D RATE is 110% of 155MM PROJ data.

NOTE 5. INF BN only. 24 HR EXPEND based on US Army Infantry Center & School data. The AT-4 is an authorized item, however, insufficient issue data precludes consideration in this study. Differences from LAW data are insignificant when considered as a fraction of total weight.

NOTE 6. ADA BN only. 24 HR EXPEND based on US Army Air Defense Center & School data.

NOTE 7: Cube Constrained

Table B-2

LID Dedicated Ammunition Vehicles

| Unit | 5/4 Ton Truck | 3/4 Ton Trailer | 5 Ton Truck | 1-1/2 Ton Trailer | Total Capacity (Short Tons) |
|---|---|---|---|---|---|
| Division | 54 | 54 | 18 | 18 | 225.00 |
| Light Inf Bn/9 Ea | 6 | 6 | 0 | 0 | 12.00 |
| H&H Co/1 Ea | 6 | 6 | 0 | 0 | 12.00 |
| Div Arty/1 Ea | 18(1) | 18(1) | 18 | 18 | 117.00 |
| 105MM F.A. Bn/3 Ea | 3 | 3 | 6 | 6 | 45.00 |
| 105MM Btry/3 Ea | 1 | 1 | 2 | 2 | 15.00 |
| 155MM Btry | 0 | 0 | 6 | 6 | 39.00 |
| ADA (Gun/Stgr) Bn/1 Ea | 6(2) | 6(2) | 0 | 0 | 12.00 |

Note: 1. Data based on an increased allocation of two additional HMMWVs per 105MM artillery battery.
2. TO&E shows no dedicated ammunition vehicles. For the purposes of this study, three HMMWVs with trailers were assigned to each of two gun/stinger batteries.

# Table B-3

## LID Materials-Handling Equipment

| LIN | DESCRIPTION | TOT (NT 1) | UNITS INVOLVED IN RESUPPLY INCLUDED IN THIS STUDY | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 ADA BN | 1 BN HHB | 1 MOTOR MAINT SEC | 1 DIV ARTY | 3 105MM / A BN | 1 H&S BTRY | 1 BN MAINT SEC | 1 155MM BTRY | 1 DIS CMM | 1 SAT BN | 1 H&S CO | 1 BN MAINT SEC | 1 CLI II IV VII SEC | 1 CL III SEC | 3 F SUP CO | 1 ORD MAINT BN | 1 HQ&LT MT CO | 1 BN MAINT SEC | 1 ORG MAINT TEAMS X3 | 1 RCVG& STOCK CONT SEC | 1 WHSE SHP SEC | 1 DIR EXC SEC | 1 ORD CO | 3 FWD SUPPO PLT | 3 AUTO MAINT SEC | 1 AVN CO | 1 GSE MHE OP MAIN SEC |
| T49119 | TRUCK LIFT FORK DSL DRVN 10000LB CAP 48IN LD CTR ROUGH TERRAIN | (21) 21 | | | | | | | | | (21) 21 | (21) 21 | | | | | (7) 7 | | | | | | | | | | | | | | |
| T48255 | TRUCK LIFT FORK DSL DRVN 6000LB CAP ROUGH TERRAIN | 14 | | | | | | | | | 14 | 10 | 4 | | 3 | 1 | 2 | 3 | 3 | | | 1 | 1 | 1 | | | | 1 | 1 |
| W1074 | TRACTOR WHL IND DSL W/BACKHOE W/LOADER W/AND TOOL ATTACHMENT | (NT 2) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A51585 | TRUCK LIFT FORK GAS 4000LB 144IN LH 66IN COLLAPS MST | (NT 3) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| K63299 | TRUCK WRECKER 5 TON 6X6 W/WINCH W/E | 13 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | | 8 | 1 | 1 | 1 | | | | 7 | 4 | 1 | 3 | | | | 3 | | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A47950 | TRUCK HAND PLATFORM W/UTILITY TYPE W/6K CAP HANDLES | 14 | | | | | | | | | 14 | | | | | | | 14 | 8 | | | 2 | 4 | 2 | 8 | 2 | | | |
| A47818 | TRUCK HAND PLATFORM W/OUT UTILITY TYPE | 13 | | | | | | | | | 13 | | | | | | | 13 | 7 | | | 1 | 4 | 2 | 8 | 2 | | | |

NOTE 1 Ammunition MHE in parentheses

NOTE 2 None in units considered in this study, however service MHE has been recommended by key LID personnel for ammunition logistics in units with high tonnage requirements

NOTE 3 None in units considered in this study, however they are used for ammunition handling by units not included in the study

# APPENDIX C

## AMMUNITION EXPENDITURES AND TRANSPORTATION REQUIREMENTS (HEAVY DEFENSE)

## Table C-1

## 24-Hour Ammunition Expenditures (Heavy Defense)

TOE: 07015L000
TYP BN: LIGHT INF

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 0 | 2400 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 6 | 100 | 600 | 12 | 50 | 36 | 1.39 | 2340 | 1.63 | 8.31% |
| 81 MM | MORT | 4 | 88 | 352 | 3 | 118 | 30 | 3.93 | 4583 | 9.01 | 46.07% |
| 105 MM | HOW | 0 | 467 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 207 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 228 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW (NOTE 1) | – | – | 42 | 15 | 3 | 3 | 1.00 | 425 | 0.21 | 1.09% |
| MISSILE | STINGER | – | – | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 18 | 4 | 72 | 1 | 72 | 20 | 3.60 | 1454 | 2.62 | 13.38% |
| MISSILE | TOW | 4 | 10 | 40 | 1 | 40 | 12 | 3.33 | 1127 | 1.88 | 9.60% |
| 5.56 MM | RIFLE | 502 | 90 | 45180 | 1680 | 27 | 48 | 0.56 | 3547 | 1.00 | 5.10% |
| 5.56 MM | SAW | 58 | 320 | 18560 | 1680 | 12 | 48 | 0.25 | 3955 | 0.49 | 2.53% |
| 7.62 MM | MG | 18 | 393 | 7074 | 800 | 9 | 40 | 0.23 | 3312 | 0.37 | 1.90% |
| 50 CAL | MG | 0 | 159 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 58 | 19 | 1102 | 50 | 23 | 21 | 1.10 | 1214 | 0.66 | 3.40% |
| 66 MM | MRL M202 | 9 | 10 | 90 | 4 | 23 | 2 | 11.50 | 294 | 1.69 | 8.64% |
| | | | | | | | TOTAL | 26.89 | | 19.57 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

## Table C-2

## 24-Hour Ammunition Expenditures (Heavy Defense)

TOE: 06125L000
TYP BN: ARTY (L I D )

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 0 | 2400 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 100 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 88 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 18 | 467 | 8406 | 2 | 4203 | 15 | 280.20 | 1934 | 270.95 | 99.32% |
| 155 MM PROJ | HOW | 0 | 207 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 228 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | -- | -- | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | -- | -- | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 4 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 10 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 400 | 90 | 36000 | 1680 | 22 | 48 | 0.46 | 3547 | 0.81 | 0.30% |
| 5.56 MM | SAW | 0 | 320 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 34 | 393 | 13362 | 800 | 17 | 40 | 0.43 | 3312 | 0.70 | 0.26% |
| 50 CAL | MG | 1 | 159 | 159 | 200 | 1 | 48 | 0.02 | 3691 | 0.04 | 0.01% |
| 40 MM | RFL GREN | 26 | 19 | 494 | 50 | 10 | 21 | 0.48 | 1214 | 0.29 | 0.11% |
| 66 MM | MRL M202 | 0 | 10 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | | TOTAL | 281.58 | | 272.80 | 100.00% |

Table C-3

24-Hour Ammunition Expenditures (Heavy Defense)

TOE: 06127 (MTOE)
TYP BN: 155 MM BTRY

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 0 | 2400 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 100 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 88 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 467 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 8 | 207 | 1656 | 1 | 1656 | 8 | 207.00 | 797 | 82.49 | 71.32% |
| 155 PROP CH | HOW | 8 | 228 | 1824 | 1 | 1824 | 50 | 36.48 | 1780 | 32.47 | 28.07% |
| MISSILE | LAW | -- | - | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | - | - | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 4 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 10 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 135 | 90 | 12150 | 1680 | 8 | 48 | 0.17 | 3547 | 0.30 | 0.26% |
| 5.56 MM | SAW | 0 | 320 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 13 | 393 | 5109 | 800 | 7 | 40 | 0.18 | 3312 | 0.29 | 0.25% |
| 50 CAL | MG | 0 | 159 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 9 | 19 | 171 | 50 | 4 | 21 | 0.19 | 1214 | 0.12 | 0.10% |
| 66 MM | MRL M202 | 0 | 10 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | | TOTAL | 244.01 | | 115.66 | 100.00% |

Table C-4

24-Hour Ammunition Expenditures (Heavy Defense)

TOE: 44115L000
TYP BN: ADA (GUN STGR)

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 18 | 2400 | 43200 | 100 | 432 | 24 | 18.00 | 2223 | 20.01 | 78.88% |
| 60 MM | MORT | 0 | 100 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 88 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 467 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 207 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 228 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | -- | -- | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STGR (NOTE 1) | -- | -- | 82 | 1 | 82 | 9 | 9.11 | 952 | 4.34 | 17.10% |
| MISSILE | DRAGON | 0 | 4 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 10 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 313 | 90 | 28170 | 1680 | 17 | 48 | 0.35 | 3547 | 0.63 | 2.48% |
| 5.56 MM | SAW | 0 | 320 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 12 | 393 | 4716 | 800 | 6 | 40 | 0.15 | 3312 | 0.25 | 0.98% |
| 50 CAL | MG | 0 | 159 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 12 | 19 | 228 | 50 | 5 | 21 | 0.24 | 1214 | 0.14 | 0.57% |
| 66 MM | MRL M202 | 0 | 10 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | | TOTAL | 27.85 | | 25.36 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

Table C-5

Committed Light Infantry Brigade: 24-Hour Ammunition Expenditures (Heavy Defense)

BATTALIONS: 3 LIGHT INF 1 ARTY (L.I.D.) 0.33 155 MM BTRY 0.33 ADA (GUN/STGR)

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BDE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 6 | 2400 | 14400 | 100 | 144 | 24 | 6.00 | 2223 | 6.67 | 1.74% |
| 60 MM | MORT | 18 | 100 | 1800 | 12 | 150 | 36 | 4.17 | 2340 | 4.88 | 1.27% |
| 81 MM | MORT | 12 | 88 | 1056 | 3 | 352 | 30 | 11.73 | 4583 | 26.89 | 7.02% |
| 105 MM | HOW | 18 | 467 | 8406 | 2 | 4203 | 15 | 280.20 | 1934 | 270.95 | 70.77% |
| 155 MM PROJ | HOW | 3 | 207 | 621 | 1 | 621 | 8 | 77.63 | 797 | 30.93 | 8.08% |
| 155 PROP CH | HOW | 3 | 228 | 684 | 1 | 684 | 50 | 13.68 | 1780 | 12.18 | 3.18% |
| MISSILE | LAW (NOTE 1) | -- | -- | 126 | 15 | 9 | 3 | 3.00 | 425 | 0.64 | 0.17% |
| MISSILE | STGR (NOTE 1) | -- | -- | 27 | 1 | 27 | 9 | 3.00 | 952 | 1.43 | 0.37% |
| MISSILE | DRAGON | 54 | 4 | 216 | 1 | 216 | 20 | 10.80 | 1454 | 7.85 | 2.05% |
| MISSILE | TOW | 12 | 10 | 120 | 1 | 120 | 12 | 10.00 | 1127 | 5.64 | 1.47% |
| 5.56 MM | RIFLE | 2055 | 90 | 184950 | 1680 | 111 | 48 | 2.31 | 3547 | 4.10 | 1.07% |
| 5.56 MM | SAW | 174 | 320 | 55680 | 1680 | 34 | 48 | 0.71 | 3955 | 1.40 | 0.37% |
| 7.62 MM | MG | 96 | 393 | 37728 | 800 | 48 | 40 | 1.20 | 3312 | 1.99 | 0.52% |
| 50 CAL | MG | 1 | 159 | 159 | 200 | 1 | 48 | 0.02 | 3691 | 0.04 | 0.01% |
| 40 MM | RFL GREN | 207 | 19 | 3933 | 50 | 79 | 21 | 3.76 | 1214 | 2.28 | 0.60% |
| 66 MM | MRL M202 | 27 | 10 | 270 | 4 | 68 | 2 | 34.00 | 294 | 5.00 | 1.31% |
| | | | | | | | TOTAL | 462.21 | | 382.85 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

## Table C-6

### Light Infantry Division: 24-Hour Ammunition Expenditures (Heavy Defense)

BATTALIONS: 9 LIGHT INF 3 ARTY (L I D ) 1 155 MM BTRY 1 ADA (GUN/STGR)

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of DIV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 18 | 2400 | 43200 | 100 | 432 | 24 | 18.00 | 2223 | 20.01 | 1.82% |
| 60 MM | MORT | 54 | 100 | 5400 | 12 | 450 | 36 | 12.50 | 2340 | 14.63 | 1.33% |
| 81 MM | MORT | 36 | 88 | 3168 | 3 | 1056 | 30 | 35.20 | 4583 | 80.66 | 7.32% |
| 105 MM | HOW | 54 | 467 | 25218 | 2 | 12609 | 15 | 840.60 | 1934 | 812.86 | 73.80% |
| 155 MM PROJ | HOW | 8 | 207 | 1656 | 1 | 1656 | 8 | 207.00 | 797 | 82.49 | 7.49% |
| 155 PROP CH | HOW | 0 | 228 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW (NOTE 1) | – | – | 378 | 15 | 26 | 3 | 8.67 | 425 | 1.84 | 0.17% |
| MISSILE | STGR (NOTE 1) | – | – | 82 | 1 | 82 | 9 | 9.11 | 952 | 4.34 | 0.39% |
| MISSILE | DRAGON | 162 | 4 | 648 | 1 | 648 | 20 | 32.40 | 1454 | 23.55 | 2.14% |
| MISSILE | TOW | 36 | 10 | 360 | 1 | 360 | 12 | 30.00 | 1127 | 16.91 | 1.53% |
| 5.56 MM | RIFLE | 6166 | 90 | 554940 | 1680 | 331 | 48 | 6.90 | 3547 | 12.23 | 1.11% |
| 5.56 MM | SAW | 522 | 320 | 167040 | 1680 | 100 | 48 | 2.08 | 3955 | 4.12 | 0.37% |
| 7.62 MM | MG | 289 | 393 | 113577 | 800 | 142 | 40 | 3.55 | 3312 | 5.88 | 0.53% |
| 50 CAL | MG | 3 | 159 | 477 | 200 | 3 | 48 | 0.06 | 3691 | 0.12 | 0.01% |
| 40 MM | RFL GREN | 621 | 19 | 11799 | 50 | 236 | 21 | 11.24 | 1214 | 6.82 | 0.62% |
| 66 MM | MRL M202 | 81 | 10 | 810 | 4 | 203 | 2 | 101.50 | 294 | 14.92 | 1.35% |
| | | | | | | | TOTAL | 1318.81 | | 1101.37 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

Table C-7

Committed Light Infantry Brigade Recap
Type of Ammunition and Quantity (Short Tons) Per Day by Type of Battalion (Heavy Defense)

| | TYPE BATTALION | | | | | |
|---|---|---|---|---|---|---|
| # IN BDE= | 3 | 1 | 0.33 | 0.33 | | |
| TYPE AMMO | LIGHT IN. | 105 MM ARTY | 155 MM BTRY | ADA (GUN/STGR) | TOTAL | % OF TOTAL |
| 20 MM | 0.00 | 0.00 | 0.00 | 6.67 | 6.67 | 1.76% |
| 60 MM | 4.88 | 0.00 | 0.00 | 0.00 | 4.88 | 1.29% |
| 81 MM | 27.04 | 0.00 | 0.00 | 0.00 | 27.04 | 7.13% |
| 105 MM | 0.00 | 270.95 | 0.00 | 0.00 | 270.95 | 71.44% |
| 155 MM PROJ | 0.00 | 0.00 | 27.50 | 0.00 | 27.50 | 7.25% |
| 155 PROP CH | 0.00 | 0.00 | 10.82 | 0.00 | 10.82 | 2.85% |
| LAW | 0.64 | 0.00 | 0.00 | 0.00 | 0.64 | 0.17% |
| STINGER | 0.00 | 0.00 | 0.00 | 1.45 | 1.45 | 0.38% |
| DRAGON | 7.85 | 0.00 | 0.00 | 0.00 | 7.85 | 2.07% |
| TOW | 5.64 | 0.00 | 0.00 | 0.00 | 5.64 | 1.49% |
| 5.56 MM | 2.99 | 0.81 | 0.10 | 0.21 | 4.11 | 1.08% |
| 5.56 MM (SAW) | 1.48 | 0.70 | 0.00 | 0.08 | 2.27 | 0.60% |
| 7.62 MM | 1.12 | 0.70 | 0.10 | 0.08 | 2.00 | 0.53% |
| 50 CAL | 0.00 | 0.04 | 0.00 | 0.00 | 0.04 | 0.01% |
| 40 MM | 1.99 | 0.29 | 0.04 | 0.05 | 2.37 | 0.62% |
| 66 MM | 5.07 | 0.00 | 0.00 | 0.00 | 5.07 | 1.34% |
| TOTAL | 58.70 | 273.50 | 38.55 | 8.54 | 379.29 | 100.00% |

Table C-8

24-Hour Ammunition Transportation Requirements (Heavy Defense)

TOE: 07015L000
TYPE BN: LIGHT INF
TRANS: 5/4 TON TRK-(6); 3/4 TON TRLR-(6)

| | |
|---|---|
| AVAIL TRANS (TONS): | 12.00 |
| 1/3 OF AVAIL TRANS: | 4.00 |
| EXPECTED EXPEND (TONS): | 19.57 |
| RATIO TRANS/EXPEND: | 0.61 |
| RESUPPLY TRIPS / 24 HR: | 4.89 |

| TYPE AMMO | WEAPON | BASIC LOAD | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 24 HR EXPEND | RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
| 20 MM | ADA GUN | 0 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 600 | 368 | 12 | 31 | 36 | 0.86 | 2340 | 1.01 | 8.36% |
| 81 MM | MORT | 352 | 216 | 3 | 72 | 30 | 2.40 | 4583 | 5.50 | 45.61% |
| 105 MM | HOW | 0 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW (NOTE 1) | 42 | 26 | 15 | 2 | 3 | 0.67 | 425 | 0.14 | 1.17% |
| MISSILE | STINGER | 0 | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 72 | 45 | 1 | 45 | 20 | 2.25 | 1454 | 1.64 | 13.57% |
| MISSILE | TOW | 40 | 25 | 1 | 25 | 12 | 2.08 | 1127 | 1.17 | 9.74% |
| 5.56 MM | RIFLE | 45180 | 27710 | 1680 | 17 | 48 | 0.35 | 3547 | 0.63 | 5.21% |
| 5.56 MM | SAW | 18560 | 11383 | 1680 | 7 | 48 | 0.15 | 3955 | 0.29 | 2.39% |
| 7.62 MM | MG | 7074 | 4339 | 800 | 6 | 40 | 0.15 | 3312 | 0.25 | 2.06% |
| 50 CAL | MG | 0 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 1102 | 676 | 50 | 14 | 21 | 0.67 | 1214 | 0.40 | 3.36% |
| 66 MM | MRL M202 | 90 | 56 | 4 | 14 | 2 | 7.00 | 294 | 1.03 | 8.53% |
| | | | | | | TOTAL | 16.58 | | 12.06 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

Table C-9

24-Hour Ammunition Transportation Requirements (Heavy Defense)

TOE: 06125L000
TYPE BN: ARTY (L.I.D.)
TRANS: 5 TON TRK-(6); 1 1/2 TON TRLR-(6)
5/4 TON TRK-(3); 3/4 TON TRLR-(3)

AVAIL TRANS (TONS): 45.00
1/3 OF AVAIL TRANS: 15.00
EXPECTED EXPEND (TONS): 272.80
RATIO TRANS/EXPEND: 0.16
RESUPPLY TRIPS / 24 HR: 18.19

| | | BASIC LOAD | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TYPE AMMO | WEAPON | 24 HR EXPEND | RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
| 20 MM | ADA GUN | 0 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 8406 | 1387 | 2 | 694 | 15 | 46.27 | 1934 | 44.74 | 99.18% |
| 155 MM PROJ | HOW | 0 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | 0 | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | 0 | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 36000 | 5939 | 1680 | 4 | 48 | 0.08 | 3547 | 0.15 | 0.33% |
| 5.56 MM | SAW | 0 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 13362 | 2205 | 800 | 3 | 40 | 0.08 | 3312 | 0.12 | 0.28% |
| 50 CAL | MG | 159 | 27 | 200 | 1 | 48 | 0.02 | 3691 | 0.04 | 0.09% |
| 40 MM | RFL GREN | 494 | 82 | 50 | 2 | 21 | 0.10 | 1214 | 0.06 | 0.13% |
| 66 MM | MRL M202 | 0 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | TOTAL | 46.54 | | 45.11 | 100.00% |

Table C-10

24-Hour Ammunition Transportation Requirements (Heavy Defense)

TOE: 06127 (MTOE)
TYPE BN: 155 MM BTRY
TRANS: 5 TON TRK-(6); 1 1/2 TON TRLR-(6)

AVAIL TRANS (TONS): 39.00
1/3 OF AVAIL TRANS: 13.00
EXPECTED EXPEND (TONS): 115.66
RATIO TRANS/EXPEND: 0.34
RESUPPLY TRIPS / 24 HR: 8.90

| | | | BASIC LOAD | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TYPE AMMO | WEAPON | 24 HR EXPEND | RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
| 20 MM | ADA GUN | 0 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 1656 | 559 | 1 | 559 | 8 | 69.88 | 797 | 27.85 | 71.21% |
| 155 PROP CH | HOW | 1824 | 616 | 1 | 616 | 50 | 12.32 | 1780 | 10.96 | 28.04% |
| MISSILE | LAW | 0 | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | 0 | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 12150 | 4097 | 1680 | 3 | 48 | 0.06 | 3547 | 0.11 | 0.28% |
| 5.56 MM | SAW | 0 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 5109 | 1723 | 800 | 3 | 40 | 0.08 | 3312 | 0.12 | 0.32% |
| 50 CAL | MG | 0 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 171 | 58 | 50 | 2 | 21 | 0.10 | 1214 | 0.06 | 0.15% |
| 66 MM | MRL M202 | 0 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | TOTAL | 82.43 | | 39.10 | 100.00% |

## Table C-11

## 24-Hour Ammunition Transportation Requirements (Heavy Defense)

TOE: 44115L000
TYPE BN: ADA (GUN/STGR)
TRANS: 5/4 TON TRK-(6); 3/4 TON TRLR-(6)

AVAIL TRANS (TONS): 12.00
1/3 OF AVAIL TRANS: 4.00
EXPECTED EXPEND (TONS): 25.36
RATIO TRANS/EXPEND: 0.47
RESUPPLY TRIPS / 24 HR: 6.34

| TYPE AMMO | WEAPON | BASIC LOAD | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 24 HR EXPEND | RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
| 20 MM | ADA GUN | 43200 | 20438 | 100 | 205 | 24 | 8.54 | 2223 | 9.49 | 78.70% |
| 60 MM | MORT | 0 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | 0 | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STGR (NOTE 1) | 82 | 39 | 1 | 39 | 9 | 4.33 | 952 | 2.06 | 17.10% |
| MISSILE | DRAGON | 0 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 28170 | 13328 | 1680 | 8 | 48 | 0.17 | 3547 | 0.30 | 2.45% |
| 5.56 MM | SAW | 0 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 4716 | 2232 | 800 | 3 | 40 | 0.08 | 3312 | 0.12 | 1.03% |
| 50 CAL | MG | 0 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 228 | 108 | 50 | 3 | 21 | 0.14 | 1214 | 0.09 | 0.72% |
| 66 MM | MRL M202 | 0 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | TOTAL | 13.26 | | 12.06 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

# APPENDIX D

## AMMUNITION EXPENDITURES AND TRANSPORTATION REQUIREMENTS (HEAVY OFFENSE)

Table D-1

24-Hour Ammunition Expenditures (Heavy Offense)

TOE: 07015L000
TYP BN: LIGHT INF

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 0 | 1793 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 6 | 80 | 480 | 12 | 40 | 36 | 1.11 | 2340 | 1.30 | 8.76% |
| 81 MM | MORT | 4 | 66 | 264 | 3 | 88 | 30 | 2.93 | 4583 | 6.72 | 45.32% |
| 105 MM | HOW | 0 | 381 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 153 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 169 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW (NOTE 1) | -- | -- | 34 | 15 | 3 | 3 | 1.00 | 425 | 0.21 | 1.43% |
| MISSILE | STINGER | -- | -- | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 18 | 3 | 54 | 1 | 54 | 20 | 2.70 | 1454 | 1.96 | 13.23% |
| MISSILE | TOW | 4 | 8 | 32 | 1 | 32 | 12 | 2.67 | 1127 | 1.50 | 10.13% |
| 5.56 MM | RIFLE | 502 | 67 | 33634 | 1680 | 21 | 48 | 0.44 | 3547 | 0.78 | 5.23% |
| 5.56 MM | SAW | 58 | 256 | 14848 | 1680 | 9 | 48 | 0.19 | 3955 | 0.37 | 2.50% |
| 7.62 MM | MG | 18 | 295 | 5310 | 800 | 7 | 40 | 0.18 | 3312 | 0.29 | 1.95% |
| 50 CAL | MG | 0 | 120 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 58 | 15 | 870 | 50 | 18 | 21 | 0.86 | 1214 | 0.52 | 3.51% |
| 66 MM | MRL M202 | 9 | 7 | 63 | 4 | 16 | 2 | 8.00 | 294 | 1.18 | 7.93% |
| | | | | | | | TOTAL | 20.07 | | 14.83 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

## Table D-2

## 24-Hour Ammunition Expenditures (Heavy Offense)

TOE: 06125L000
TYP BN: ARTY (L I D )

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 0 | 1793 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 80 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 66 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 18 | 381 | 6858 | 2 | 3429 | 15 | 228.60 | 1934 | 221.06 | 99.37% |
| 155 MM PROJ | HOW | 0 | 153 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 169 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | - | - | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | - | - | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 3 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 8 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 400 | 67 | 26800 | 1680 | 16 | 48 | 0.33 | 3547 | 0.59 | 0.27% |
| 5.56 MM | SAW | 0 | 256 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 34 | 295 | 10030 | 800 | 13 | 40 | 0.33 | 3312 | 0.54 | 0.24% |
| 50 CAL | MG | 1 | 120 | 120 | 200 | 1 | 48 | 0.02 | 3691 | 0.04 | 0.02% |
| 40 MM | RFL GREN | 26 | 15 | 390 | 50 | 8 | 21 | 0.38 | 1214 | 0.23 | 0.10% |
| 66 MM | MRL M202 | 0 | 7 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | | TOTAL | 229.66 | | 222.46 | 100.00% |

## Table D-3

## 24-Hour Ammunition Expenditures (Heavy Offense)

TOE: 06127 (MTOE)
TYP BN: 155 MM BTRY

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 0 | 1793 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 80 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 66 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 381 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 8 | 153 | 1224 | 1 | 1224 | 8 | 153.00 | 797 | 60.97 | 71.27% |
| 155 PROP CH | HOW | 8 | 169 | 1352 | 1 | 1352 | 50 | 27.04 | 1780 | 24.07 | 28.13% |
| MISSILE | LAW | – | – | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | – | – | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 3 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 8 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 135 | 67 | 9045 | 1680 | 6 | 48 | 0.13 | 3547 | 0.22 | 0.26% |
| 5.56 MM | SAW | 0 | 256 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 13 | 295 | 3835 | 800 | 5 | 40 | 0.13 | 3312 | 0.21 | 0.24% |
| 50 CAL | MG | 0 | 120 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 9 | 15 | 135 | 50 | 3 | 21 | 0.14 | 1214 | 0.09 | 0.10% |
| 66 MM | MRL M202 | 0 | 7 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | | TOTAL | 180.43 | | 85.55 | 100.00% |

## Table D-4

## 24-Hour Ammunition Expenditures (Heavy Offense)

TOE: 44115L000
TYP BN: ADA (GUN/STGR)

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 18 | 1793 | 32274 | 100 | 323 | 24 | 13.46 | 2223 | 14.96 | 71.24% |
| 60 MM | MORT | 0 | 80 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 66 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 381 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 153 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 169 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | – | – | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STGR (NOTE 1) | – | – | 99 | 1 | 99 | 9 | 11.00 | 952 | 5.24 | 24.94% |
| MISSILE | DRAGON | 0 | 3 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 8 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 313 | 67 | 20971 | 1680 | 13 | 48 | 0.27 | 3547 | 0.48 | 2.29% |
| 5.56 MM | SAW | 0 | 256 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 12 | 295 | 3540 | 800 | 5 | 40 | 0.13 | 3312 | 0.21 | 0.99% |
| 50 CAL | MG | 0 | 120 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 12 | 15 | 180 | 50 | 4 | 21 | 0.19 | 1214 | 0.12 | 0.55% |
| 66 MM | MRL M202 | 0 | 7 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | | TOTAL | 25.04 | | 21.00 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

Table D-5

Committed Light Infantry Brigade: 24-Hour Ammunition Expenditures (Heavy Offense)

BATTALIONS: 3 LIGHT INF 1 ARTY (L I D ) 0.33 155 MM BTRY 0.33 ADA (GUN/STGR)

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BDE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 6 | 1793 | 10758 | 100 | 108 | 24 | 4.50 | 2223 | 5.00 | 1.64% |
| 60 MM | MORT | 18 | 80 | 1440 | 12 | 120 | 36 | 3.33 | 2340 | 3.90 | 1.28% |
| 81 MM | MORT | 12 | 66 | 792 | 3 | 264 | 30 | 8.80 | 4583 | 20.17 | 6.60% |
| 105 MM | HOW | 18 | 381 | 6858 | 2 | 3429 | 15 | 228.60 | 1934 | 221.06 | 72.32% |
| 155 MM PROJ | HOW | 3 | 153 | 459 | 1 | 459 | 8 | 57.38 | 797 | 22.86 | 7.48% |
| 155 PROP CH | HOW | 3 | 169 | 507 | 1 | 507 | 50 | 10.14 | 1780 | 9.02 | 2.95% |
| MISSILE | LAW (NOTE 1) | -- | -- | 102 | 15 | 7 | 3 | 2.33 | 425 | 0.50 | 0.16% |
| MISSILE | STGR (NOTE 1) | -- | -- | 33 | 1 | 33 | 9 | 3.67 | 952 | 1.75 | 0.57% |
| MISSILE | DRAGON | 54 | 3 | 162 | 1 | 162 | 20 | 8.10 | 1454 | 5.89 | 1.93% |
| MISSILE | TOW | 12 | 8 | 96 | 1 | 96 | 12 | 8.00 | 1127 | 4.51 | 1.47% |
| 5.56 MM | RIFLE | 2055 | 67 | 137685 | 1680 | 82 | 48 | 1.71 | 3547 | 3.03 | 0.99% |
| 5.56 MM | SAW | 174 | 256 | 44544 | 1680 | 27 | 48 | 0.56 | 3955 | 1.11 | 0.36% |
| 7.62 MM | MG | 96 | 295 | 28320 | 800 | 36 | 40 | 0.90 | 3312 | 1.49 | 0.49% |
| 50 CAL | MG | 1 | 120 | 120 | 200 | 1 | 48 | 0.02 | 3691 | 0.04 | 0.01% |
| 40 MM | RFL GREN | 207 | 15 | 3105 | 50 | 63 | 21 | 3.00 | 1214 | 1.82 | 0.60% |
| 66 MM | MRL M202 | 27 | 7 | 189 | 4 | 48 | 2 | 24.00 | 294 | 3.53 | 1.15% |
| | | | | | | | TOTAL | 365.04 | | 305.67 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

## Table D-6

## Light Infantry Division: 24-Hour Ammunition Expenditures (Heavy Offense)

BATTALIONS: 9 LIGHT INF 3 ARTY (L I D ) 1 155 MM BTRY 1 ADA (GUN/STGR)

| TYPE AMMO | WEAPON | QNTY | R/T/D RATE | 24 HR EXPEND | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of DIV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 18 | 1793 | 32274 | 100 | 323 | 24 | 13.46 | 2223 | 14.96 | 1.70% |
| 60 MM | MORT | 54 | 80 | 4320 | 12 | 360 | 36 | 10.00 | 2340 | 11.70 | 1.33% |
| 81 MM | MORT | 36 | 66 | 2376 | 3 | 792 | 30 | 26.40 | 4583 | 60.50 | 6.86% |
| 105 MM | HOW | 54 | 381 | 20574 | 2 | 10287 | 15 | 685.80 | 1934 | 663.17 | 75.19% |
| 155 MM PROJ | HOW | 8 | 153 | 1224 | 1 | 1224 | 8 | 153.00 | 797 | 60.97 | 6.91% |
| 155 PROP CH | HOW | 0 | 169 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW (NOTE 1) | -- | -- | 306 | 15 | 21 | 3 | 7.00 | 425 | 1.49 | 0.17% |
| MISSILE | STGR (NOTE 1) | -- | -- | 99 | 1 | 99 | 9 | 11.00 | 952 | 5.24 | 0.59% |
| MISSILE | DRAGON | 162 | 3 | 486 | 1 | 486 | 20 | 24.30 | 1454 | 17.67 | 2.00% |
| MISSILE | TOW | 36 | 8 | 288 | 1 | 288 | 12 | 24.00 | 1127 | 13.52 | 1.53% |
| 5.56 MM | RIFLE | 6166 | 67 | 413122 | 1680 | 246 | 48 | 5.13 | 3547 | 9.09 | 1.03% |
| 5.56 MM | SAW | 522 | 256 | 133632 | 1680 | 80 | 48 | 1.67 | 3955 | 3.30 | 0.37% |
| 7.62 MM | MG | 289 | 295 | 85255 | 800 | 107 | 40 | 2.68 | 3312 | 4.43 | 0.50% |
| 50 CAL | MG | 3 | 120 | 360 | 200 | 2 | 48 | 0.04 | 3691 | 0.08 | 0.01% |
| 40 MM | RFL GREN | 621 | 15 | 9315 | 50 | 187 | 21 | 8.90 | 1214 | 5.41 | 0.61% |
| 66 MM | MRL M202 | 81 | 7 | 567 | 4 | 142 | 2 | 71.00 | 294 | 10.44 | 1.18% |
| | | | | | | | TOTAL | 1044.37 | | 881.94 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

Table D-7

Committed Light Infantry Brigade Recap
Type of Ammunition and Quantity (Short Tons) Per Day by Type of Battalion (Heavy Offense)

| | TYPE BATTALION | | | | | |
|---|---|---|---|---|---|---|
| # IN BDE= | 3 | 1 | 0.33 | 0.33 | | |
| TYPE AMMO | LIGHT INF | 105 MM ARTY | 155 MM BTRY | ADA (GUN/STGR) | TOTAL | % OF TOTAL |
| 20 MM | 0.00 | 0.00 | 0.00 | 4.99 | 4.99 | 1.65% |
| 60 MM | 3.90 | 0.00 | 0.00 | 0.00 | 3.90 | 1.29% |
| 81 MM | 20.17 | 0.00 | 0.00 | 0.00 | 20.17 | 6.65% |
| 105 MM | 0.00 | 221.06 | 0.00 | 0.00 | 221.06 | 72.94% |
| 155 MM PROJ | 0.00 | 0.00 | 20.32 | 0.00 | 20.32 | 6.71% |
| 155 PROP CH | 0.00 | 0.00 | 8.02 | 0.00 | 8.02 | 2.65% |
| LAW | 0.64 | 0.00 | 0.00 | 0.00 | 0.64 | 0.21% |
| STINGER | 0.00 | 0.00 | 0.00 | 1.75 | 1.75 | 0.58% |
| DRAGON | 5.89 | 0.00 | 0.00 | 0.00 | 5.89 | 1.94% |
| TOW | 4.51 | 0.00 | 0.00 | 0.00 | 4.51 | 1.49% |
| 5.56 MM | 2.33 | 0.59 | 0.07 | 0.16 | 3.15 | 1.04% |
| 5.56 MM (SAW) | 1.11 | 0.54 | 0.00 | 0.07 | 1.72 | 0.57% |
| 7.62 MM | 0.87 | 0.54 | 0.07 | 0.07 | 1.55 | 0.51% |
| 50 CAL | 0.00 | 0.04 | 0.00 | 0.00 | 0.04 | 0.01% |
| 40 MM | 1.56 | 0.23 | 0.03 | 0.04 | 1.86 | 0.61% |
| 66 MM | 3.53 | 0.00 | 0.00 | 0.00 | 3.53 | 1.16% |
| TOTAL | 44.50 | 222.99 | 28.52 | 7.07 | 303.08 | 100.00% |

Table D-8

24-Hour Ammunition Transportation Requirements (Heavy Offense)

TOE: 07015L000
TYPE BN: LIGHT INF
TRANS: 5/4 TON TRK-(6); 3/4 TON TRLR-(6)

AVAIL TRANS (TONS): 12.00
1/3 OF AVAIL TRANS: 4.00
EXPECTED EXPEND (TONS): 14.83
RATIO TRANS/EXPEND: 0.81
RESUPPLY TRIPS / 24 HR: 3.71

| | | | BASIC LOAD | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TYPE AMMO | WEAPON | 24 HR EXPEND | RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
| 20 MM | ADA GUN | 0 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 480 | 389 | 12 | 33 | 36 | 0.92 | 2340 | 1.07 | 8.84% |
| 81 MM | MORT | 264 | 214 | 3 | 72 | 30 | 2.40 | 4583 | 5.50 | 45.34% |
| 105 MM | HOW | 0 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW (NOTE 1) | 34 | 28 | 15 | 2 | 3 | 0.67 | 425 | 0.14 | 1.17% |
| MISSILE | STINGER | 0 | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 54 | 44 | 1 | 44 | 20 | 2.20 | 1454 | 1.60 | 13.19% |
| MISSILE | TOW | 32 | 26 | 1 | 26 | 12 | 2.17 | 1127 | 1.22 | 10.07% |
| 5.56 MM | RIFLE | 33634 | 27211 | 1680 | 17 | 48 | 0.35 | 3547 | 0.63 | 5.18% |
| 5.56 MM | SAW | 14848 | 12013 | 1680 | 8 | 48 | 0.17 | 3955 | 0.33 | 2.72% |
| 7.62 MM | MG | 5310 | 4296 | 800 | 6 | 40 | 0.15 | 3312 | 0.25 | 2.05% |
| 50 CAL | MG | 0 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 870 | 704 | 50 | 15 | 21 | 0.71 | 1214 | 0.43 | 3.57% |
| 66 MM | MRL M202 | 63 | 51 | 4 | 13 | 2 | 6.50 | 294 | 0.96 | 7.88% |
| | | | | | | TOTAL | 16.24 | | 12.13 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

Table D-9

24-Hour Ammunition Transportation Requirements (Heavy Offense)

TOE: 06125L000
TYPE BN: ARTY (L.I.D.)
TRANS: 5 TON TRK-(6); 1 1/2 TON TRLR-(6); 5/4 TON TRK-(3); 3/4 TON TRLR-(3)

| | |
|---|---|
| AVAIL TRANS (TONS): | 45.00 |
| 1/3 OF AVAIL TRANS: | 15.00 |
| EXPECTED EXPEND (TONS): | 222.46 |
| RATIO TRANS/EXPEND: | 0.20 |
| RESUPPLY TRIPS / 24 HR: | 14.83 |

| | | BASIC LOAD | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TYPE AMMO | WEAPON | 24 HR EXPEND | RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
| 20 MM | ADA GUN | 0 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 6858 | 1388 | 2 | 694 | 15 | 46.27 | 1934 | 44.74 | 99.18% |
| 155 MM PROJ | HOW | 0 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | 0 | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | 0 | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 26800 | 5422 | 1680 | 4 | 48 | 0.08 | 3547 | 0.15 | 0.33% |
| 5.56 MM | SAW | 0 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 10030 | 2029 | 800 | 3 | 40 | 0.08 | 3312 | 0.12 | 0.28% |
| 50 CAL | MG | 120 | 25 | 200 | 1 | 48 | 0.02 | 3691 | 0.04 | 0.09% |
| 40 MM | RFL GREN | 390 | 79 | 50 | 2 | 21 | 0.10 | 1214 | 0.06 | 0.13% |
| 66 MM | MRL M202 | 0 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | TOTAL | 46.54 | | 45.11 | 100.00% |

## Table D-10

## 24-Hour Ammunition Transportation Requirements (Heavy Offense)

TOE: 06127 (MTOE)
TYPE BN: 155 MM BTRY
TRANS: 5 TON TRK-(6); 1 1/2 TON TRLR-(6)

AVAIL TRANS (TONS): 39.00
1/3 OF AVAIL TRANS: 13.00
EXPECTED EXPEND (TONS): 85.55
RATIO TRANS/EXPEND: 0.46
RESUPPLY TRIPS / 24 HR: 6.58

| TYPE AMMO | WEAPON | 24 HR EXPEND | BASIC LOAD RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 MM | ADA GUN | 0 | 0 | 100 | 0 | 24 | 0.00 | 2223 | 0.00 | 0.00% |
| 60 MM | MORT | 0 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 1224 | 558 | 1 | 558 | 8 | 69.75 | 797 | 27.80 | 71.14% |
| 155 PROP CH | HOW | 1352 | 617 | 1 | 617 | 50 | 12.34 | 1780 | 10.98 | 28.11% |
| MISSILE | LAW | 0 | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STINGER | 0 | 0 | 1 | 0 | 9 | 0.00 | 952 | 0.00 | 0.00% |
| MISSILE | DRAGON | 0 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 9045 | 4124 | 1680 | 3 | 48 | 0.06 | 3547 | 0.11 | 0.28% |
| 5.56 MM | SAW | 0 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 3835 | 1749 | 800 | 3 | 40 | 0.08 | 3312 | 0.12 | 0.32% |
| 50 CAL | MG | 0 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 135 | 62 | 50 | 2 | 21 | 0.10 | 1214 | 0.06 | 0.15% |
| 66 MM | MRL M202 | 0 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | TOTAL | 82.32 | | 39.07 | 100.00% |

Table D-11

## 24-Hour Ammunition Transportation Requirements (Heavy Offense)

TOE: 44115L000
TYPE BN: ADA (GUN/STGR)
TRANS: 5/4 TON TRK-(6); 3/4 TON TRLR-(6)

AVAIL TRANS (TONS): 12.00
1/3 OF AVAIL TRANS: 4.00
EXPECTED EXPEND (TONS): 21.00
RATIO TRANS/EXPEND: 0.57
RESUPPLY TRIPS / 24 HR: 5.25

| TYPE AMMO | WEAPON | BASIC LOAD | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 24 HR EXPEND | RND/ LOAD | RND/ PACK | TOTAL PACK | PACK/ PALLET | TOTAL PALLET | WEIGHT/ PALLET | TOTAL TONS | % TONS of BN |
| 20 MM | ADA GUN | 32274 | 18445 | 100 | 185 | 24 | 7.71 | 2223 | 8.57 | 70.87% |
| 60 MM | MORT | 0 | 0 | 12 | 0 | 36 | 0.00 | 2340 | 0.00 | 0.00% |
| 81 MM | MORT | 0 | 0 | 3 | 0 | 30 | 0.00 | 4583 | 0.00 | 0.00% |
| 105 MM | HOW | 0 | 0 | 2 | 0 | 15 | 0.00 | 1934 | 0.00 | 0.00% |
| 155 MM PROJ | HOW | 0 | 0 | 1 | 0 | 8 | 0.00 | 797 | 0.00 | 0.00% |
| 155 PROP CH | HOW | 0 | 0 | 1 | 0 | 50 | 0.00 | 1780 | 0.00 | 0.00% |
| MISSILE | LAW | 0 | 0 | 15 | 0 | 3 | 0.00 | 425 | 0.00 | 0.00% |
| MISSILE | STGR (NOTE 1) | 99 | 57 | 1 | 57 | 9 | 6.33 | 952 | 3.01 | 24.94% |
| MISSILE | DRAGON | 0 | 0 | 1 | 0 | 20 | 0.00 | 1454 | 0.00 | 0.00% |
| MISSILE | TOW | 0 | 0 | 1 | 0 | 12 | 0.00 | 1127 | 0.00 | 0.00% |
| 5.56 MM | RIFLE | 20971 | 11985 | 1680 | 8 | 48 | 0.17 | 3547 | 0.30 | 2.45% |
| 5.56 MM | SAW | 0 | 0 | 1680 | 0 | 48 | 0.00 | 3955 | 0.00 | 0.00% |
| 7.62 MM | MG | 3540 | 2024 | 800 | 3 | 40 | 0.08 | 3312 | 0.12 | 1.03% |
| 50 CAL | MG | 0 | 0 | 200 | 0 | 48 | 0.00 | 3691 | 0.00 | 0.00% |
| 40 MM | RFL GREN | 180 | 103 | 50 | 3 | 21 | 0.14 | 1214 | 0.09 | 0.72% |
| 66 MM | MRL M202 | 0 | 0 | 4 | 0 | 2 | 0.00 | 294 | 0.00 | 0.00% |
| | | | | | | TOTAL | 14.43 | | 12.09 | 100.00% |

NOTE 1: Total 24HR EXPEND not R/T/D RATE.

# APPENDIX E

# PHOTOGRAPHS AND DRAWINGS

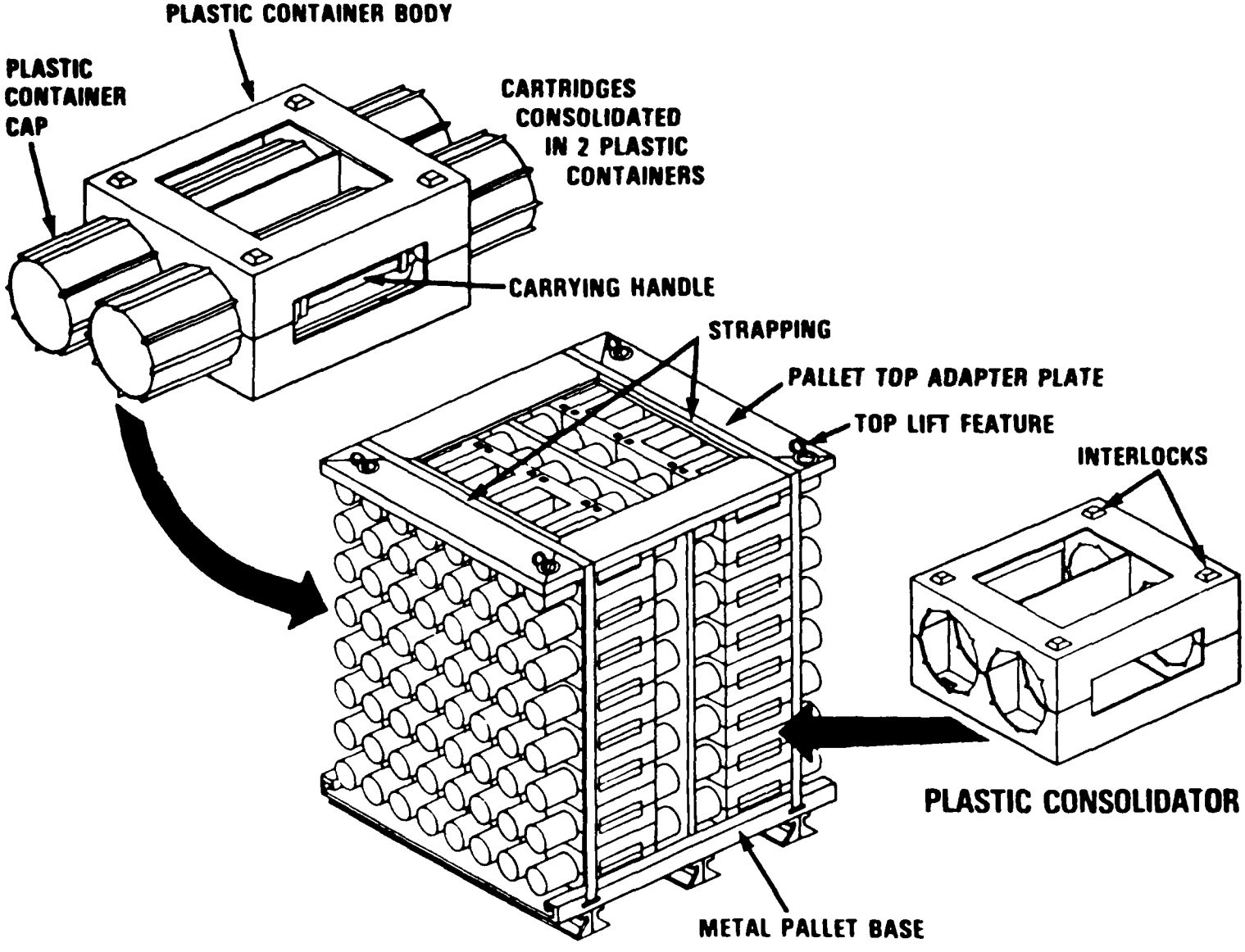
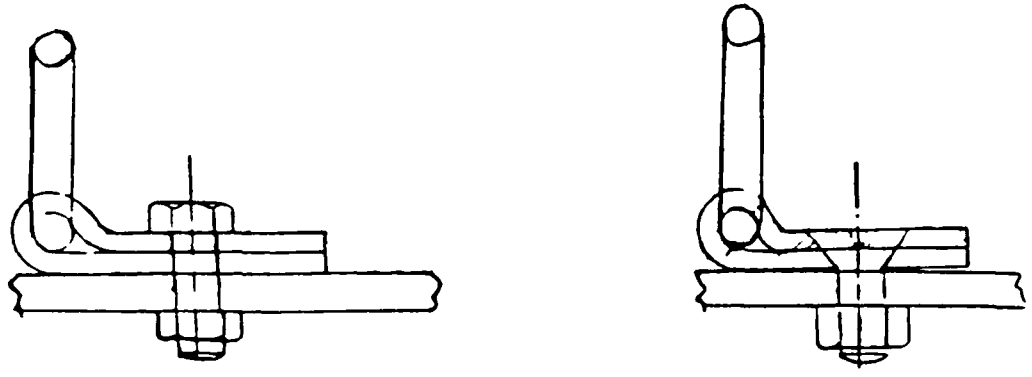



Figure E-1. 81mm mortar pallet concept.



CURRENT RETAINER

NEW RETAINER

Figure E-2. HMMWV improved cargo tie-downs (projected modification).

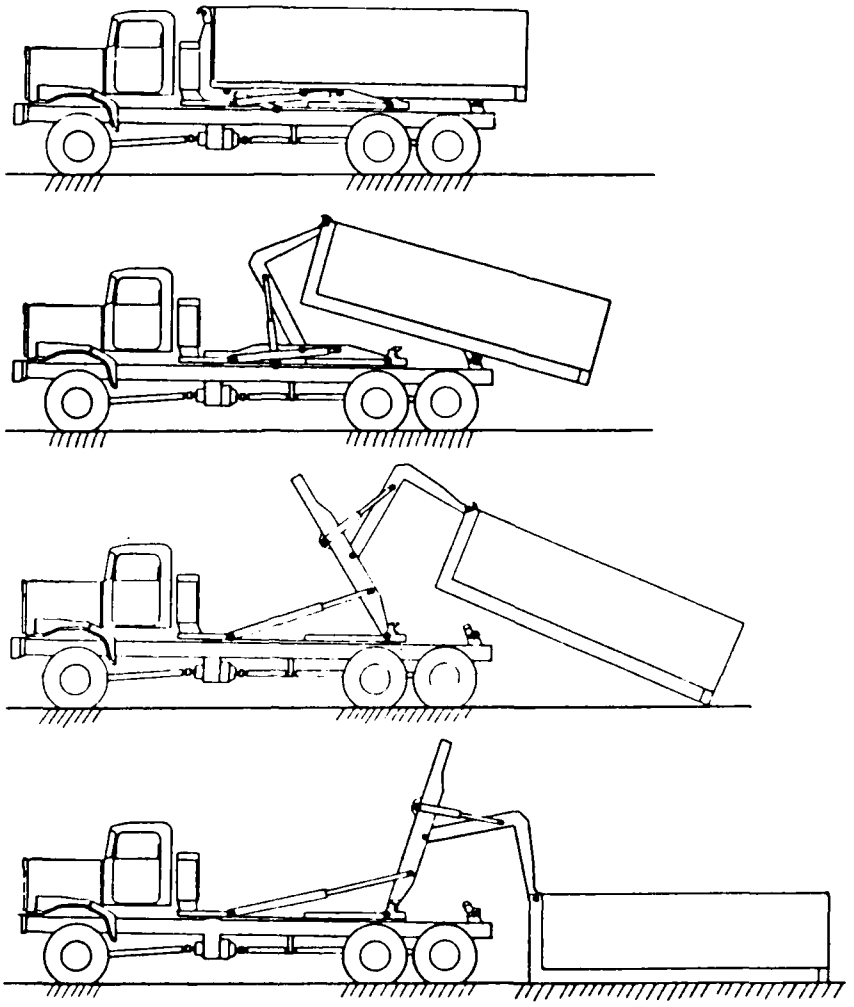
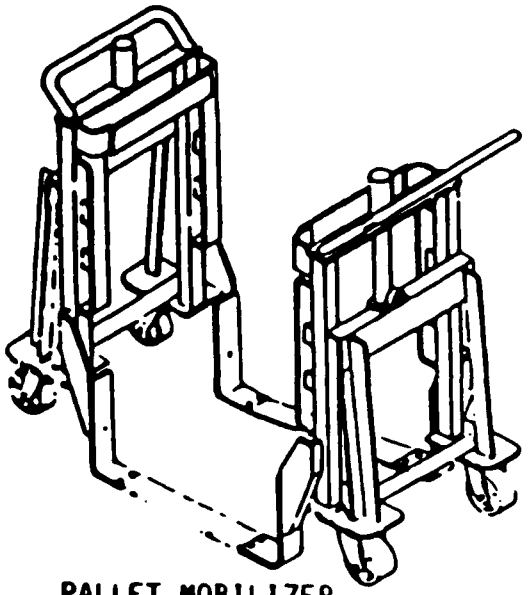
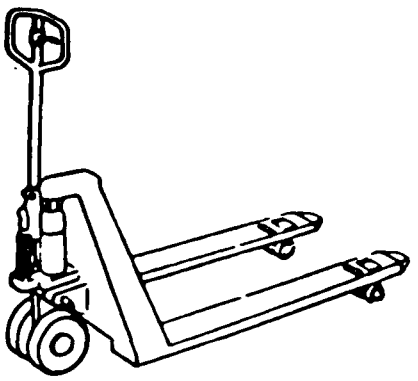


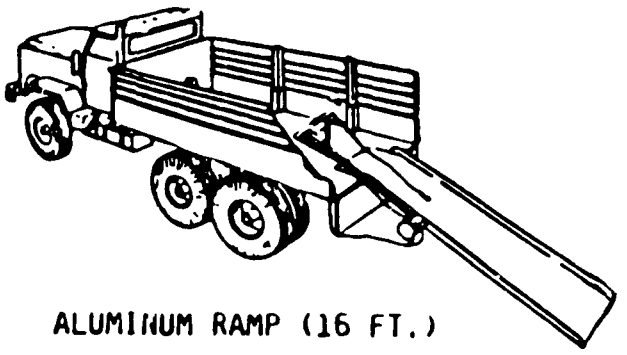
Figure E-3. Palletized loading system.



PALLET MOBILIZER



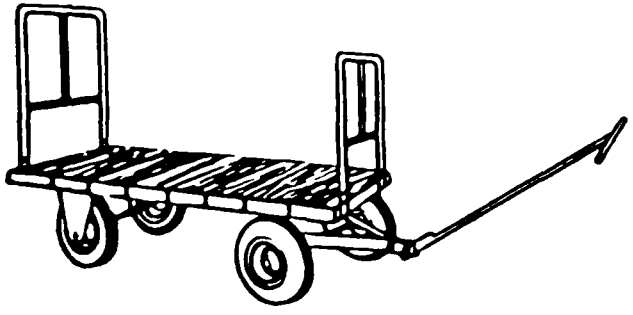
PALLET TRUCK (JACK)



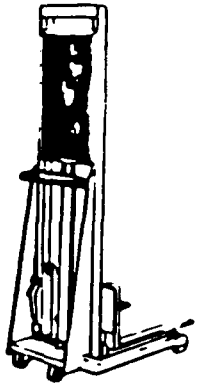
ALUMINUM RAMP (16 FT.)

ELECTRIC CAPSTAN (24V)

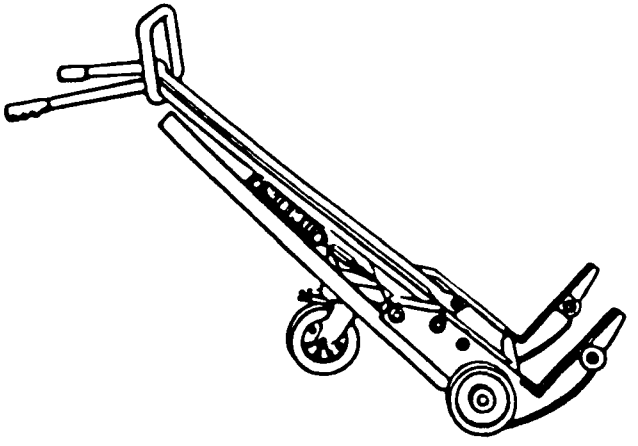
JIB BOOMS (W/MOUNTING BRACKET)



WAGON TRUCK



STRADDLE PALLET STACKER



PROJECTILE PALLET HAND TRUCK

FOR 155MM & 8" PROJECTILES

Figure E-4. Unit basic load-upload equipment.

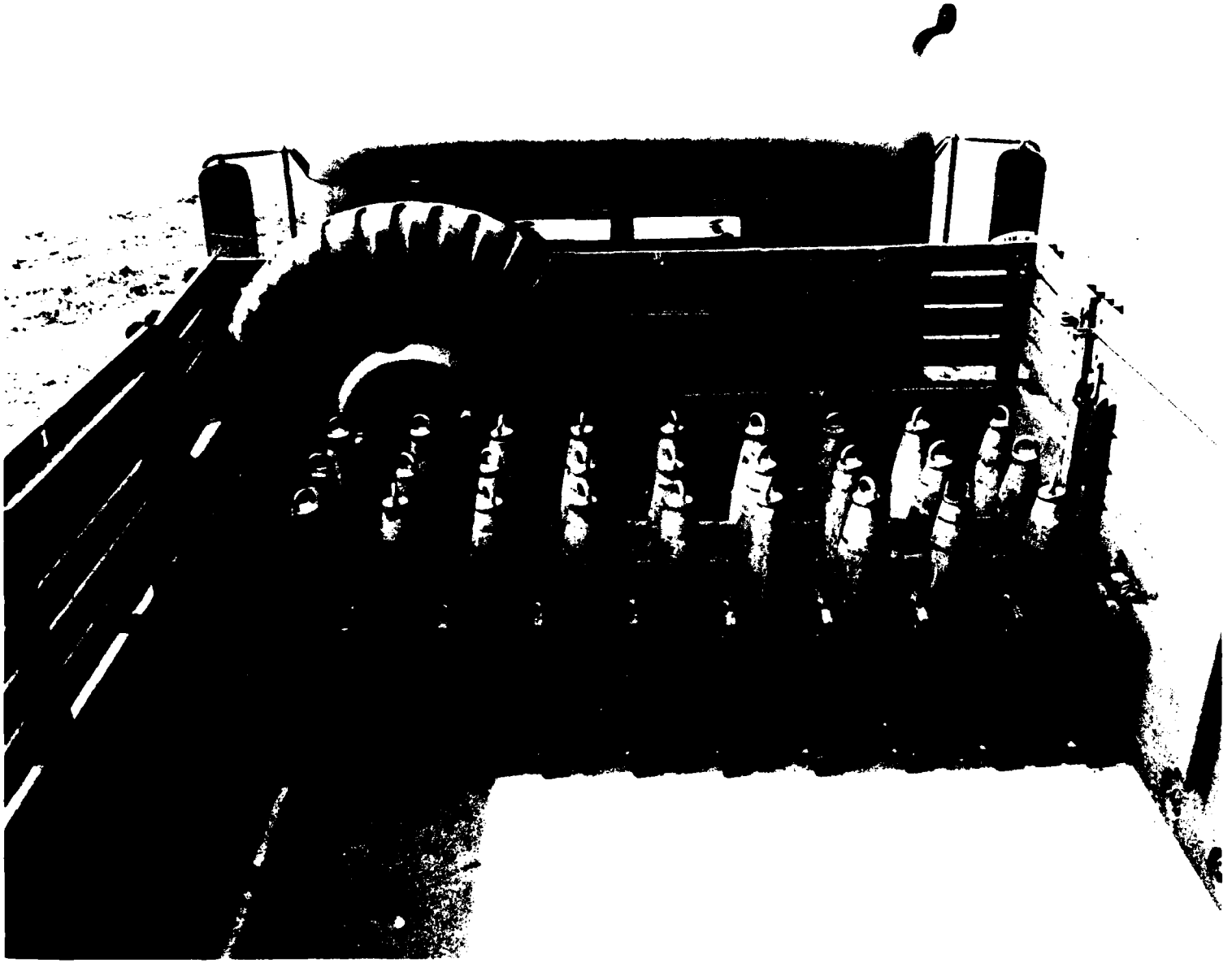


Figure E-5. Loose projectile restraint system (LPRS).

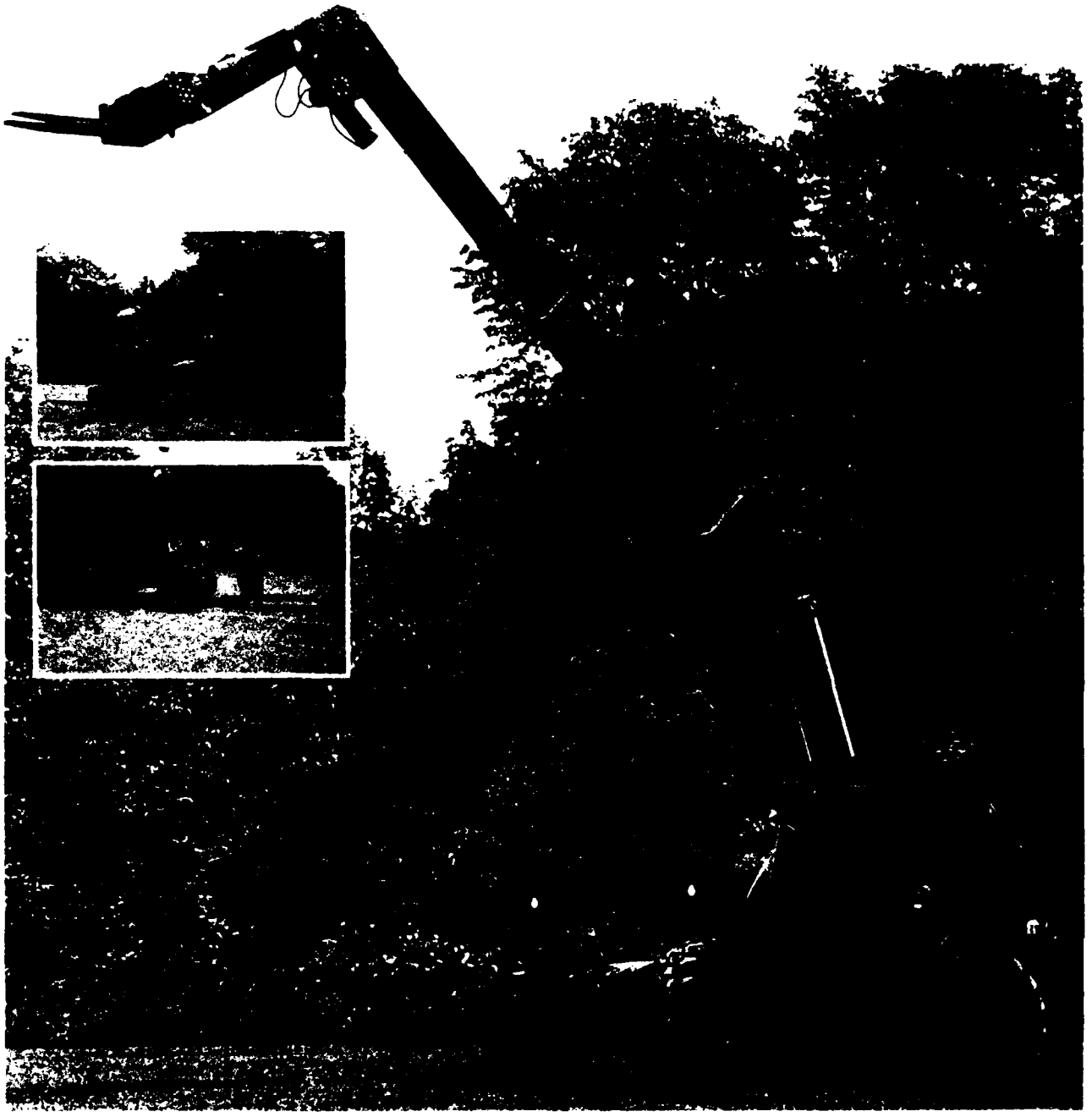


Figure E-6. Variable reach rough terrain forklift (VRRTFL).